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AMERICAN ANTIQUITY

VOL. XXIII JULY, 1957 No. 1

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EDITORIAL —— HOW MUCH IS A PAGE OF ARCHAEOLOGY WORTH TO YOU?

ARCHAEOLOGICAL RESEARCH is useful only insofar as its results become widely available through publication. The Society for American Archaeology has an unsurpassed opportunity to put information of basic importance into libraries around the world and into the hands of scholars and interested readers through AMERICAN ANTIQUITY and through its Memoir series.

BUT, publication (not merely printing) of archaeological information, detailed and well illustrated, is expensive ($15 to $20 a page) and the amount we publish is severely limited by the funds we have available. With no capital and no endowment, we must depend on dues, supplemented by sales of earlier issues, occasional gifts from generous and interested friends, and grants solicited from foundations. Our officers all serve without compensation, of course, so that about 90% of our expenditures can go into our publications. Only part of the income from our increased dues can go for expanding our activities, as most of it is needed to meet rising costs and to permit a reduction of engraving charges to authors.

The Society has accepted for publication, and will publish if funds can be obtained, a comprehensive report by Clarence H. Webb on the Belcher Site in Louisiana, an extremely important Caddoan site, and also a symposium on the Archaic assembled by Douglas S. Byers, with significant papers on the Archaic from the Atlantic Coast to the Pacific by a number of prominent archaeologists. These Memoirs, both expected to run to 200 to 300 pages, and generously illustrated, will go to all members free of charge, when published.

We have in press, with funds for publication assured, Memoir 14, the final report on Danger Cave, by J. D. Jennings, being published jointly with the University of Utah, and Memoir 15, on Yucatán Maya pottery making, by R. H. Thompson. Other important studies languish in manuscript form, unpublished and relatively unknown, for lack of funds. We can divert no more than a small part of our regular income to Memoirs, as the journal and the operation of the Society require the bulk of it. Therefore, we hope that some of our members — or nonmember friends — will help with gifts, either large or small, so that a continual growth of our publication program will be possible, to match the continued growth of archaeological discoveries and understanding.

The Society for American Archaeology, like other nonprofit organizations, enjoys the privilege of receiving tax-exempt gifts, according to an interpretation by the Office of Internal Revenue, dated July 7, 1945, under section 101 (6) of the Internal Revenue Code, as follows:

> Contributions made to you are deductible by the donors in arriving at their taxable net income in the manner and to the extent provided by section 23 (o) and (q) of the Internal Revenue Code, as amended, and corresponding provisions of prior revenue acts. Bequests, legacies, devices or transfers, to or for your use are deductible in arriving at the value of the net estate of a decedent for estate tax purposes in the manner and to the extent provided by sections 812 (d) and 861 (a) (3) of the Code and/or corresponding provisions of prior revenue acts. Gifts of property to you are deductible in computing net gifts for gift tax purposes in the manner and to the extent provided in section 1004 (a) (2) (B) and 1004 (b) (2) and (3) of the Code and/or corresponding provisions of prior revenue acts.

While a gift to the Society of substantial size can immediately aid in the publication of a Memoir, smaller gifts are also extremely welcome, as they can aid in building our funds for future publication.

Gifts to the Society for American Archaeology should be sent to the Treasurer, JAMES A. SWAUGER, Carnegie Museum, Pittsburgh 13, Pennsylvania.

AN ALLUVIAL SITE ON THE SAN CARLOS INDIAN RESERVATION, ARIZONA*

EMIL W. HAURY

THE MOUNTAINOUS belt of east-central Arizona has produced little evidence bearing on the problem of human history prior to the introduction of pottery and agriculture and the development of village life. In terms of the Christian calendar the events since about A.D. 1 are understood with varying degrees of clarity and reliability, but before the beginning of the Christian era the record for this region is still largely a void. The nature of the terrain, composed mainly of mountains with narrow, steeply pitching, and deeply entrenched valleys, has been unfavorable for the formation of the kind of alluvial deposits in which early human remains are often found. But there is no reason to suppose that the ecology of a mountainous region was less attractive to people of a primitive subsistence economy than were the plains or the broad low-lying intermountain valleys. The work in west-central New Mexico by Martin, Rinaldo, and Antevs (1949) and in Bat Cave by Dick (1952, 1954) has pointed up the fact that the higher altitudes and rough terrain were not deterrents to occupation. The discovery, therefore, of an alluvial site (Arizona W:10:112, Arizona State Museum Survey) in the Cienega Creek valley near Point of Pines (Fig. 1) in the summer of 1955 merely emphasizes what may be expected in the occasional valley or geologic situation in mountain country where all the conditions of man's presence, of his leaving his "tracks," and of nature's blanketing them with earth, later to uncover them again, are brought together in a way which permits decipherment.

The location of such favored spots will require a more systematic and persistent search and a closer scrutiny of the ground than is generally necessary elsewhere. The site in question abundantly illustrates this point. As early as 1941, the potentiality of Cienega Creek as a source of early human remains was recognized by E. B. Sayles. Here, a narrow valley, partly filled with flat-lying alluvial beds and now being exposed by arroyo trenching, provided the physical requisites for "gully archaeology." Frequent observations of the arroyo after 1946 netted occasional fragments of chipped stone in the talus but never anything in place in the arroyo walls. Finally, on July 4, 1955, Sayles and I, in company with several others, came upon a large stone imbedded in a fine-textured laminated silt deposit (Fig. 2), which proved to be a grinding stone inverted over the companion hand stone. With this clue, indisputable evidence that man had left a functionally related combination of his tools on the spot during a period of alluviation, investigations were begun on July 6 and continued through August 3, 1955, and resumed from June 18 to June 28 in 1956.

The Cienega Valley. Cienega Creek rises under the north rim of the Nantack Ridge at an elevation of about 7000 feet and flows in an easterly to southeasterly direction, emptying eventually into Eagle Creek 15 miles away at an elevation of 4500 feet (Fig. 1). The several small intermittent streams which make up the head of the drainage system drop precipitously within canyons cut in tuff beds. They join at the base of the ridge to form the main valley. With the lessening of the gradient the valley broadens to 100 m. or so and is framed by steep valley sides composed of a heavy tuff bed capped by lava. Originally that part of the valley which concerns us here was deep, but aggradation has reduced this depth to approximately 45 m. and formed a flat valley floor with no appreciable altitudinal changes laterally. Mature pine trees grow sparsely on the valley floor,

* The University of Arizona Archaeological Field School was established at Point of Pines on the San Carlos Indian Reservation in 1946. Acknowledgment is made of the support given this venture during the early years by the Wenner-Gren Foundation for Anthropological Research and by other interested persons. Credit is also due those students who worked diligently, both in the field and in the laboratory, to provide many of the data for this paper. Special thanks are extended to H. R. Crane and James B. Griffin, of the University of Michigan, who responded wholeheartedly to our request for assistance in the area of radiocarbon analysis, and to the Research Corporation for its encouragement and support in the development of the Carbon-14 Age Determination Laboratory of the University of Arizona.

Contribution Number 5, Program in Geochronology, University of Arizona, Tucson.

Contribution to Point of Pines Archaeology, Number 10.

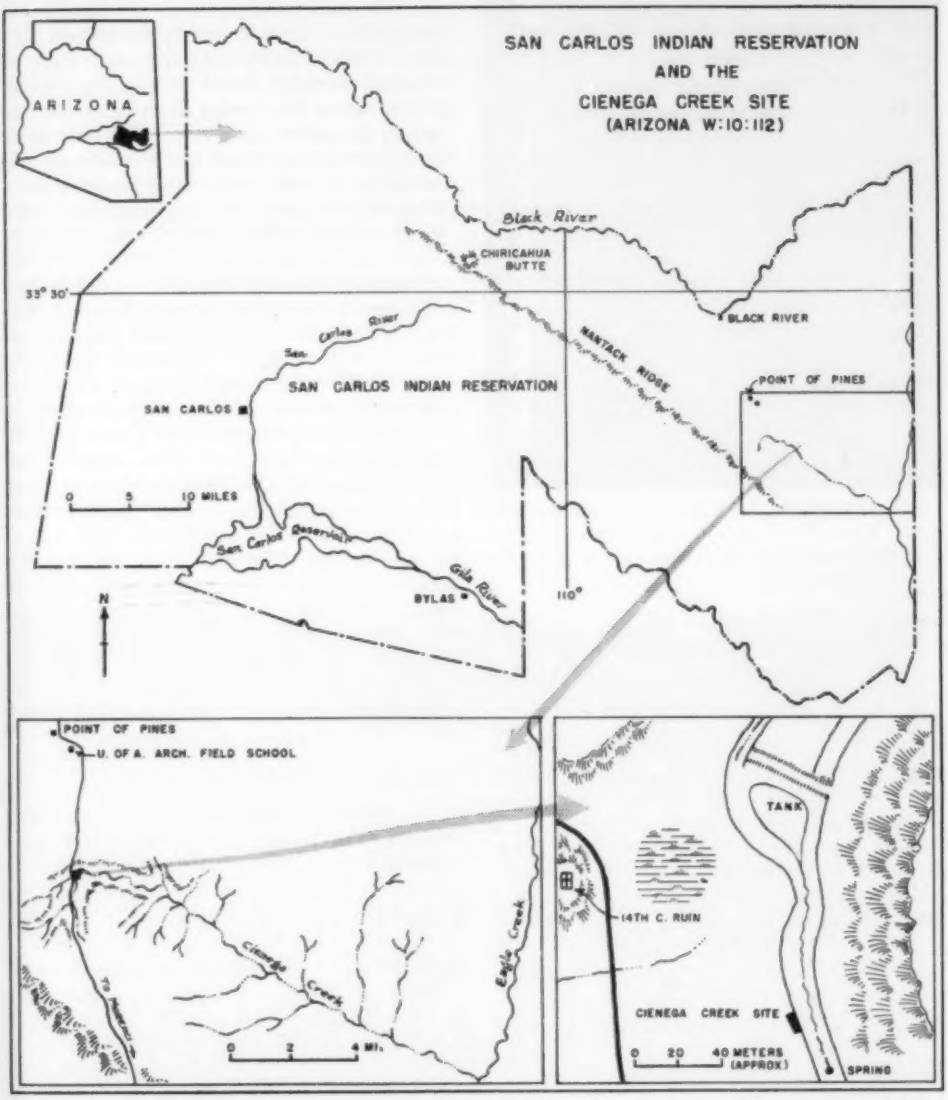

FIG. 1. Location of the Cienega Creek site, San Carlos Indian Reservation, Arizona.

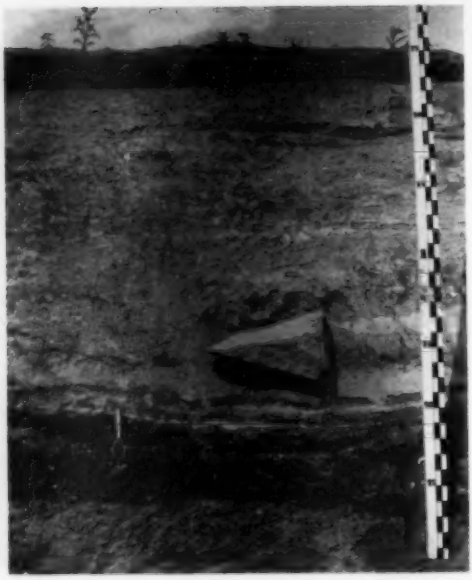

FIG. 2. Grinding stone, inverted over handstone (not visible) in Bed C-3. Trowel rests on hearthstone in Bed D-1. Profile face slopes away from camera, giving distorted impression of depth.

suggesting that stable conditions in the aggradation process were reached at least 100 years ago. Locally the valley floor becomes boggy in wet weather and, in one area of several acres, water stands for a time during the winter and summer rainy periods, producing an ephemeral marsh, or cienega, from which the creek takes its name (Fig. 3).

The present arroyo ranges in width from 10 to 20 m. and has a depth of 4 m. or less. There are no records or observations available as to the date when arroyo cutting began. Inferentially, this was not earlier than 1885 and probably was somewhat later, judged by the "young" appearance of the arroyo itself. Youthful pines, perhaps no more than 10 to 15 years of age, have sprouted in the channel bays.

As a place to live, the valley and the adjacent mesas provided a few specific attractions. In spite of the arroyo cutting adjacent to the site here discussed, water emerges in the channel floor and trickles downstream for several hundred meters. Even during the driest parts of the year this water source is unfailing. Judged on the basis of the "water holes" exposed during our excavations, put down at a time when the valley floor was much lower than today, the availability of water must have been a characteristic of the spot for a long time, and therefore a feature which would have attracted people.

The mesa tops flanking the valley, though rocky, provide patches of fertile basalt-derived soil. Man-built barriers, in the form of low stone terraces designed to impede quick surface runoff, are a common sight. These are attributable to the agricultural practices of the people who have occupied the area within the last thousand years. Their village sites, too, are easily found on the benches and the mesa top. A small stone pueblo (Arizona W:10:4) occupies the top of a tuff outcrop directly west of the alluvial site (Fig. 4). Thus, although the area was a favored spot in late prehistory, the kinds of artifacts found in these pueblo villages were not unearthed in the geological context of the valley deposits, except for a limited amount of pottery in a stratigraphically late bed. So by comparison and exclusion a long period of use of the valley may be assumed.

THE SITE

The principle human evidence in the valley deposits was limited to the area excavated, measuring 5 by 13 m. A black carbonaceous layer (D-1), the oldest culture deposit, was traced for some 25 m. north and 75 m. south of the site and it is probable that human vestiges occur at least over this lateral spread. Some chert chips and hearthstones have been picked up on the eroded slopes of the arroyo

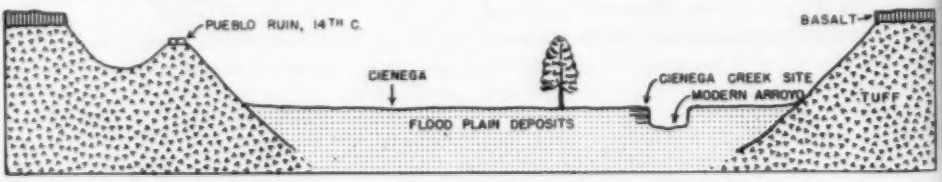

FIG. 3. Diagrammatic section of the Cienega Creek valley (roughly E-W), showing the relationship of the site to the local physiography.

even beyond these limits. The excavations recorded here appear to be in the heart of the area where human activity was most intense. It should be emphasized that the evidence of this was preserved within the clay, silt, sand, and gravel that make up the flood plain deposit of the valley. Human disturbances of the deposit remove all possibility of mere accidental or secondary inclusions in the alluvium. Excavations for fires, for water, and for the disposal of the dead stand in a relative temporal relationship to each other because as time passed, the rising valley floor was providing man with an ever-changing surface.

Our digging procedure was first to remove the talus material from the sloping arroyo face over a lateral width of 4 m. centering around the imbedded grinding stone which first led us to this spot. Next, the cutting of a vertical face made it clear that the deposits could be separated by character and that there was a series of them. As new cultural manifestations appeared, lateral digging of the area was eventually extended to 14 m. Penetration into the arroyo bank varied from 3 m. at the south end to 7 m. at the north end (Fig. 5). The maximum depth of the testing below the existing surface was 4.75 m. and the base level of the excavation below the deepest culture-bearing stratum (D-1), except for a limited test, was approximately 1.5 m. above the present arroyo floor. The face of the digging was kept vertical and the cuts into the bank varied from 0.25 to 0.50 m. slices, depending on the character of the features being dissected at the time. Approximately 200 cu. m. of dirt were removed in the operation.

Geology. The exposures of the valley deposits, visible in the present arroyo for nearly a half mile below the Cienega Creek site, and those freshly opened by our digging reveal a succession of sediments with remarkable lateral uniformity. The maximum observed depth of the formations was about 5 m. and it is probable that they go much deeper. Vertical differentiation of the sediments into beds was based on such physical characteristics as tex-

FIG. 4. Panoramic view of Cienega Creek site (center) looking west. Arrow indicates 14th century pueblo ruin (Ariz. W:10:4).

ture, composition, and color. No lithological study was made. Marked erosional unconformities, important in the separation of beds due to climatic fluctuations, were not seen. Evidence for a minor erosion noted on the contact between the B-2 and C-1 beds is discussed later. The absence of such erosional features suggests a nearly continuous depositional process interrupted by occasional pauses of variable duration when some surface stability appears to have existed. This in itself is a hint that the recorded span of time need not have been great.

Unfortunately the geology of the site is of little help in reading either the chronological record or in providing much useful information of past climate. No comparable sequenc has been seen anywhere in the area and n reference points exist which allow correlatio with other geochronologies. The absence o both vertebrate and invertebrate fossils handi caps stratigraphic classification. Furthermore the uniqueness of the archaeological comple prevents ready equation with known cultura materials of an established sequence.

The following description of the beds pro ceeds from the surface downward. It is recog nized that the designation of formations in thi fashion is contrary to usual geological practic but the archaeologist who excavates in thes has need from the start to establish label before the full profile is known. This is bes done by beginning at the surface (Figs. 5, 6),

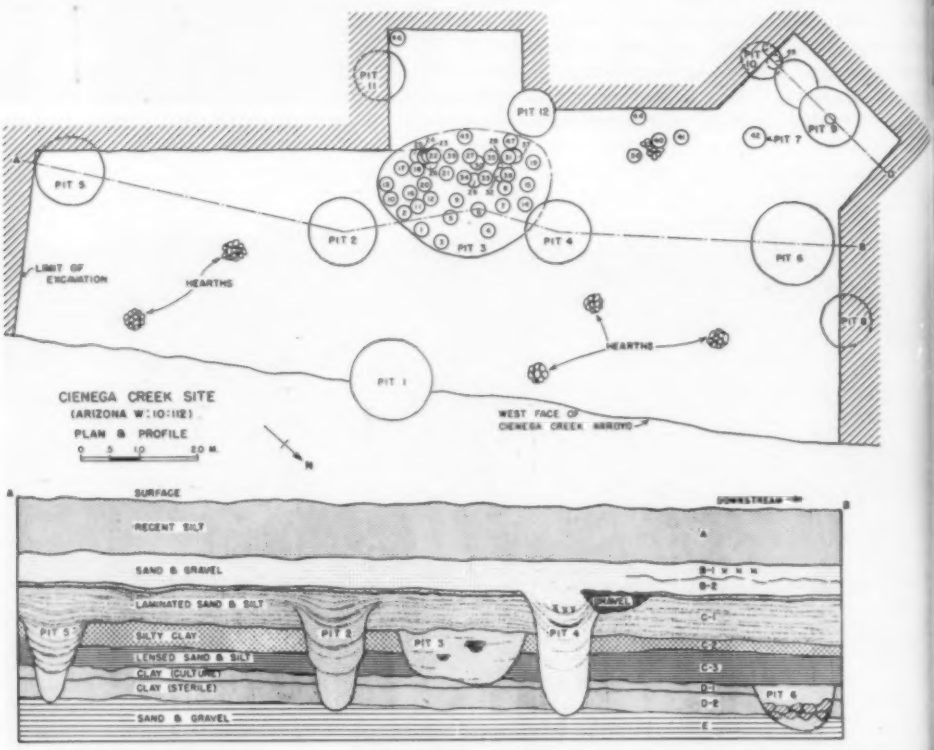

FIG. 5. Plan and profile of the Cienega Creek site, drawing attention to the vertical relationships of some of th cultural features. All hearths were on the D-1 surface and Pit 1 was dug from this surface. Circled numbers in P 3 and elsewhere represent cremations. Hachured units in Pit 6 are large rocks. Pottery sources are designated b X. The downstream dip of the beds is about 0.5 in 50.0 m. For profile C-D see Fig. 9.

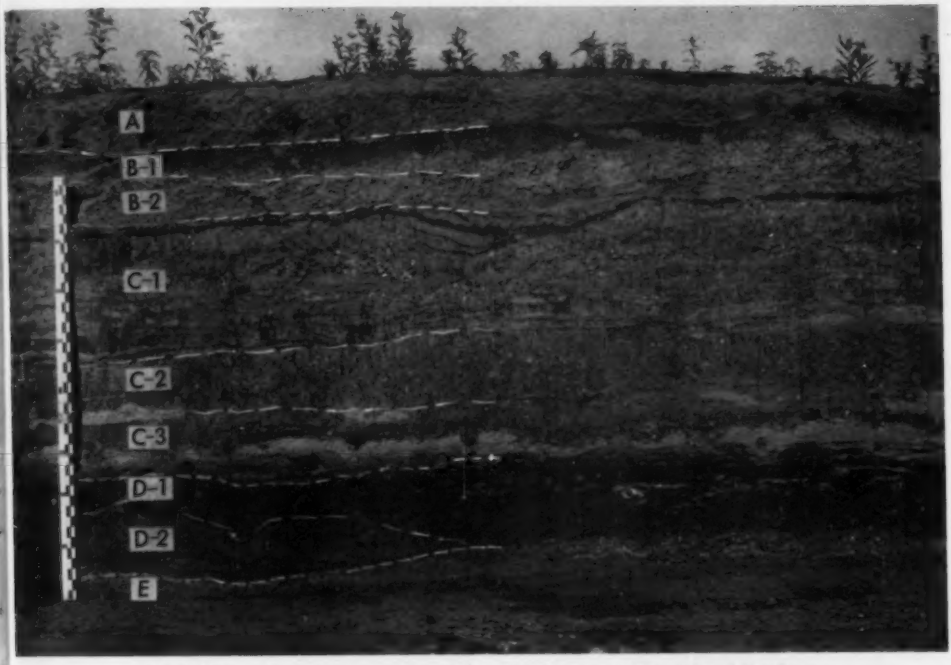

Fig. 6. The geological column of the Cienega Creek site. Scaling stick is 2.2 m. long.

Fig. 7. Pit 1 (foreground), Pit 2 (right of scale), and Pit 3 (far right). The last, containing the cremations, often with cover stones, is only partially exposed here.

	Thickness (in meters)
Bed A: Dark brown silt, some rounded pebbles; unconsolidated and structureless	0-1.0
Conformity	
Bed B: (1) Light brown silt, sand; soft; grades imperceptibly or locally changes abruptly to	0.35-0.50
(2) Light brown sand and gravel; gravel rounded tuff; unconsolidated.	
Conformity	
Bed C: (1) Light brown sand and silt, some gravel lenses; horizontal laminations of variable thickness prominent; soft. Near the top is a continuous thin (2 to 5 cm.) organically stained clayey layer, capped by 5 to 10 cm. of soft silt presenting a somewhat undulating and locally eroded surface	0.60-0.75
Conformity	
(2) Light brownish gray silty clay, tuff pebbles; hard; pinches out and reappears in area of Pits 9 and 10	0.20-0.35
(3) Light brown silt, sand, thin gravel lenses; prominent lenses of light tan sand and some horizontal laminations as in C-1. Bed thickens abruptly in northwest part of area excavated; wet and malodorous from organic content; plant remains identified (by C. T. Mason, Jr., Assistant Taxonomist, Department of Botany, University of Arizona) as probably Sedge (*Scirpus validus* or *S. acutus*), a marsh plant present in the area today; a seed of *Pinus*, probably *P. ponderosa*; a seed of *Chenopodium* sp.; and an unidentified seed	0.30-1.5
Conformity	
Bed D: (1) Dark gray clay, mixed with charcoal, hearthstones to depth of disturbance by man	0.15-0.2
(2) Dark gray clay, sterile, compact	0-0.2
Conformity	
Bed E: Light brown sand and gravel; unconsolidated; base not exposed	1.5+

FIG. 8. Profile of Pit 3 with cremations and Pit 4 (right). Upper right margin of Pit 4 partly destroyed by erosion on C-1 surface.

Fauna. Except for the cremated human bones and 2 unburned animal bone fragments associated with a cremation, no faunal remains were encountered in the excavations. Considering the food preparing activity suggested by hearths and the few grinding tools, the absence of bone offers an interesting anomoly. This is especially true for the D bed which had all of the earmarks of a camping situation, but less so for the C bed and its components which represent a period of relatively rapid aggradation during which time people made specialized use of the spot. Since 2 unburned bone artifacts did survive in the soil one may infer that soil conditions were not such as to completely destroy bone if it was ever present. More probable is the inference that food preparation was limited to vegetal materials or that some other selective factor, not now apparent, was working.

Hearths. Shallow, circular, basin-like depressions filled with fire-stained and sometimes cracked basalt rocks and charcoal have been identified as hearths. Six main hearthstone concentrations appeared, all on the surface of layer D-1 (Fig. 5). The amount of stones removed in the larger ones amounted to about a half bushel in volume. In addition, hearthstones were widely distributed through this bed, suggesting considerable cooking activity. The rocks themselves varied in size but seldom exceeded 20 cm. in diameter. The heat-resisting properties of basalt influenced the choice of basalt over tuff for use in the cooking process.

In the 3 units of bed C no hearths were noted and hearthstones were rare. Their presence has no apparent connection with the cremations and must be related to food preparation practices. In passing it should be noted that the rocks associated with cremations, often as cap stones, were of unburned tuff.

It has been generally observed that the alluvial sites of the Cochise culture yield hearthstones in abundance and that they are less common in the later villages of pottery making times. This is true of Point of Pines also where in pit-house village or pueblo they are an infrequent attribute of the site. Bed B-1, with pottery, produced none. Insofar as the local culture history is concerned the incidence of hearthstones in itself hints at some age for this site as compared with the numerous nearby ruins of pottery times.

Pits. The first feature, encountered early in the excavation, which removed all doubt about human presence on the spot and established with absolute certainty that the cultural remains were not redeposited, was a circular pit 1.5 m. in diameter and nearly as deep. Subsequent digging exposed 11 additional pits varying to some extent in size, shape, and the levels from which they were dug (Fig. 5). The sectioning method of excavation employed made for easy differentiation of the sedimentary deposits in the pits from those of the beds into which they were dug, as is clearly brought out in Figures 7 and 8. Details of the pits are as follows:

Pit 1. Dimensions: mouth diameter 1.5 m., reducing to about 1 m. at bottom; bottom flat; depth 1.4 m.

Fill: fine laminated curved silt layers with occasional hearth stones and lumps of charcoal and black clay probably derived from Bed D-1.

Level: dug from top of D-1 through this deposit and deeply into E (Fig. 7).

Pit 2. Dimensions: mouth diameter 1.3 m., with gently sloping sides converging sharply at 1 m. to make shoulder, continuing downward to form rounded bottom; depth 1.5 m.

Fill: curved, finely laminated silt and clay layers.

Level: dug from near top of C-1, through D and into sands and gravels of E (Fig. 7).

Pit 3. Dimensions: maximum diameter 3 m.; minimum diameter slightly over 2 m.; depth 1.3 m.; pit not clearly definable along western margin.

Pit 4. Dimensions: mouth diameter 1.5 m., sides converging to bottom diameter of 0.5 m.; depth 1.8 m.

Fill: curved layers of laminated silts; lenticular pocket of carbon-impregnated silt near top; potsherds in upper part.

Level: excavated after C-1 was formed and from surface separating it from B-2; penetrated D and shallowly into E (Fig. 8).

Pit 5. Dimensions: mouth diameter 1 m.; sides taper sharply to small rounded bottom; depth 1 m.

Fill: curved laminated silts in upper part, grading to clay in bottom.

Level: dug at same time at Pit 3, from top of C-2 formation; penetrated D and barely into sands of E.

Pit 6. Dimensions: diameter 1.35 m.; depth 1.75; basin-like.

Fill: silt and closely packed large rocks near bottom. Rocks suggest use of this pit as earth oven, but no direct evidence of fire seen.

Level: dug from top of D-1; penetrated E.

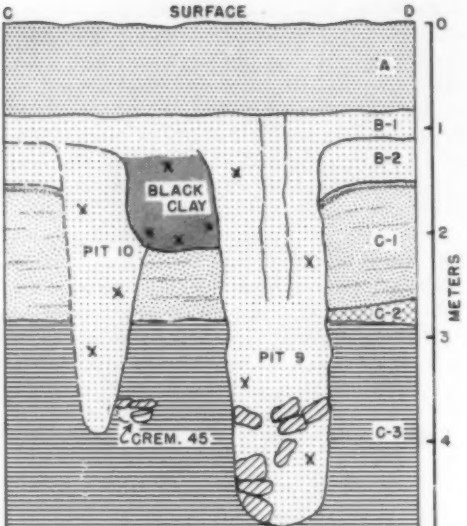

FIG. 9. Profile (C-D, Fig. 5) through wells dug within a short period of time from B-2 surface about 1000 years ago. Pottery denoted by X. Bed C at this point thick and waterlogged. Note Cremation 45 in basket.

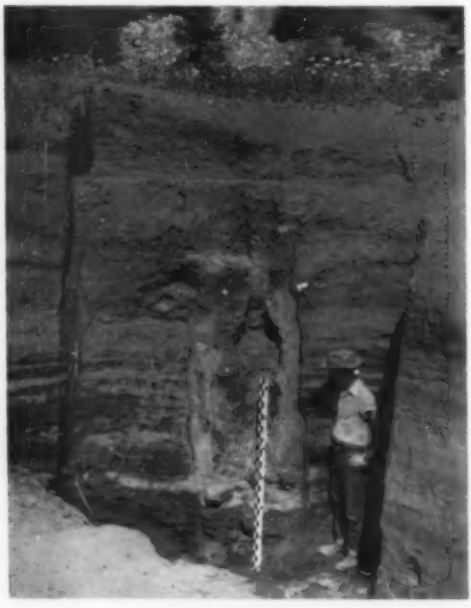

FIG. 10. Pit 9, a well nearly 4 m. deep dug from surface of B-2 layer during pottery times.

Pit 7. This pit proved to be a cremation; in bed C-1 overlying bed C-2 absent in profile due to natural pinching out or to extensive human disturbance; radiocarbon age of 2150±200 suggests pit was dug at terminal C-2 time. (See also discussion under "Cremations" and Fig. 11.)

Pit 8. Dimensions: mouth diameter 0.9 m.; depth 1.2 m.

Fill: sediments, numerous large and small fire-cracked rocks, and large (to 0.4 m.) sections of charred oak and pine logs.

Level: dug from C-3 surface; penetration into E not clearly defined due to excessive water.

Pit 9. Dimensions: average diameter 1 m.; depth 3.7 m. (Figs. 5, 9, 10); bottom rounded, sides nearly perpendicular.

Fill: mostly clean sand, with numerous large rocks near bottom, some piled up suggesting a platform for standing; some pottery througout fill. A later disturbance in fill was a bore of 0.25 m. in diameter and about 2 m. deep. This penetration postdates the formation of B-1 which itself formed after the digging and filling of Pit 9; it may represent one of several well-drilling efforts in the valley in recent years. Pit 9 seeped water so abundantly that excavation became extremely difficult.

Level: dug from B-2 surface and pentrated sands of E.

Pit 10. Dimensions: mouth diameter about 0.8 m.; tapering towards bottom; depth 2.8 m. (Figs. 5, 9).

Fill: clean sand and silt, no rocks, some pottery.

Level: excavated from B-2 surface.

Pit 11. Dimensions: diameter 0.9 m.; depth 2 m.

Fill: silts showing concave laminar structure; pottery absent.

Level: excavated from just below final surface of C-1; black clayey layer just below C-1 surface unbroken over pit; barely reached sands of E.

Pit 12. Dimensions: mouth diameter about 1 m.; depth 2.8 m.

Fill: bottom filled with gravel derived from B-2, overlain by black silty-clay and finally sand; no pottery found but pit was dug within pottery times.

Level: excavation from surface of B-1, penetrated to E.

It is clear from the foregoing that functionally 4 types of pits are represented: (1) Numbers 1, 2, 4, 5, 6, 9, 10, 11, and 12, which were comparatively small but deep, each reaching the sandy E bed and filled ultimately by natural processes of sedimentation; (2) Number 3, a large shallow pit, filled with numerous pockets of cremated bone and rocks, the contents due largely to human activity and only to a minor extent to natural filling; (3) Number 7, a small pit expressly designed to receive a single crema-

tion; and (4) Pit 8, which, judging from its contents was a large cooking pit or earth oven.

A reasonable conclusion as to the significance of the first group of pits is that they were efforts to reach water. We know that a permanent water supply exists adjacent to the site, occurring now as a spring in the arroyo floor. Flowage is sufficient to maintain a fairly constant water level in the modern cattle tank below the site (Fig. 1). Our tests, made during the dry part of the summer, showed that the water table is only 2 m. below Bed D, an inconsiderable drop in view of the drainage effects of recent arroyo cutting. All the pits in this category went through the quite impervious clay Bed D-2 into the sand and gravel below. In earlier days the water table may well have stood at the base of the D-2 bed where the supply was tapped by the pits.

As alluviation proceeded it became necessary to dig pits of increasing depth. The inference follows that no arroyo or water channel existed during deposition, otherwise surface water might have been used, making the digging of holes unnecessary. We must further infer that local inhabitants knew of this spot as a potential water source over a considerable period of time even though the periodically flooded valley floor gave no direct evidence of it. In recent years the Double Circle Cattle Company and the Indian Service built tanks and drilled wells near the site. Except during the driest part of the year, surface water is not difficult to find in the Point of Pines area and it is likely that probing for water here was a dry season activity.

The partial excavation in the Point of Pines region of large depressions 15 to 20 m. across, usually located near ruined villages dating from about A.D. 1100 or later, has shown them to be aboriginal wells (Wheat 1952). In form these resembled inverted cones, the points having been dug deeply enough (3 to 4 m.) to tap the underground water reservoir. Water was obtained by walking into the wells. Except for this feature and the size, there was little difference between the late prehistoric wells and the pits of the Cienega Creek site. Both depended on reaching the comparatively shallow subsurface reservoir. The principle, of course, is an old one. For the Point of Pines area, this system was apparently present and used for at least 4000 years and Pit 9 (Fig. 10) may be regarded as a classic example of well-digging a thousand years ago.

The second and third categories of pits are related in that the excavations were for the disposal of the cremated dead. Pit 3, with its numerous individually buried lots of bones introduces the idea of the burial plot, while Pit 7 reflects the custom of the individual burial of ashes. Pit 8, of the fourth type, while perhaps originally made in search of water, was later used for pit oven cooking. There was no evidence that it was for cremating.

THE CREMATIONS

Occurrence. Most of the cremations (40 out of 47) occurred in the restricted area of a large aboriginal excavation at least 1.3 m. deep and 3 m. in diameter. This excavation was designated Pit 3 (Figs. 5, 7, 8). It was made from the surface of Bed C-2 and gradually filled with clay-silt sediments. The structure of these sediments was observed in a few places which were not disturbed by subsequent use of the pit for burying cremated remains. Evidently as the pit was filling, shallow pockets ranging in size from 0.2 to 0.4 m. in diameter and 0.15 m. or less in depth, were scooped out of the matrix. The individual lots of bones were then put into these depressions and covered either with earth or with large flat unburned tuff slabs. These 2 methods of closure were about equally represented. In one case the bones were placed in a shallow stone tray (Cremation 8, Fig. 15 *a*). That some time elapsed between interments is indicated by vertical super-position of cremations, four in one series. How much time is represented cannot be determined, but the absence of a well-defined surface on the C-2 bed may be taken to mean that the interval was short.

The 7 cremations not in Pit 3 were scattered at random near it (Fig. 5). Most of these were no more than pockets of bone deposited from the C-2 surface and therefore of about the same age as those in Pit 3. Three deserve special attention. The first, Cremation 42, in Pit 7 (Fig. 11 *a*, *b*), was perhaps the most formal and instructive in the details preserved. This pit was 0.4 m. in diameter and 0.5 m. in depth. Some unstructured silt remained in the bottom, suggesting that either the pit was not immediately used or that it was not thoroughly cleaned out. The cremated bones were placed on the silt, capped by an unburned tuff rock. Then

followed a mass of black carbonaceous material including some bone, which is presumably the ash residue from the cremating fire. Finally several covering rocks were placed over the pit which must have been visible on the surface after the interment. Eventually these were covered by water-borne silt.

Cremation 45, in the waterlogged environment of the thickened and deep-lying C-3 bed in the northwest part of the site, produced 2 coiled baskets, one of which certainly contained cremated bone. The miraculous preservation of so fragile a material as basketry (Fig. 20) is attributable directly to the perpetually wet condition of its resting place, a circumstance which also preserved plant parts, as discussed elsewhere. This fortunate recovery of a single basket cremation, I believe, explains the preciseness of many of the depressions in which the bones were found. It is reasonable to suppose that burying the ashes in basket containers was a common practice but that, except in this one instance, direct evidence of the custom has been destroyed. In passing it should be noted that cremations with baskets and other perishable goods dating from preceramic times and attributable to eastern variants of the Basketmaker culture have been reported from the Guadalupe Mountains (Howard 1935:67-9) in New Mexico and the mouth of the Pecos River (Cosgrove 1947:162-3) in Texas.

A third cremation (No. 36) worth special notice was the lowest in terms of its stratigraphic position (Figs. 12, 23). The bones were placed in a pit dug during the early formational stages of Bed C-3 and therefore some time before the digging of Pit 3, which became the main bone disposal area. The time interval need not have been long, yet the sequence is clear.

Cremations 36, 42, and 45 are significant in demonstrating that separate pit depositories for individual bone lots were as much a part of the burial pattern as was the concentration of ashes of many persons within a large pit. This calls to mind the oldest type of cremation known for the Hohokam (Gladwin and others 1937:93-100).

That the actual incineration process was not done in the large pit (No. 3), is indicated by the absence of fire stains and deposits of wood ashes. Furthermore the bone masses clearly rest in small artificially made pockets, which means that the ashes were transported from the crematory to their final resting place. The dirt matrix containing the bones was ashen gray in color, contrasting sharply with the brownish sediment in the large pit. Small charcoal lumps had been gathered up with the bones as had water-worn tuff pebbles. Highly carbonaceous material was observed in 4 instances. In several cases the bones formed a clinker-like mass bound together by a yellow material. Whether this was the product of firing or of long burial is not known.

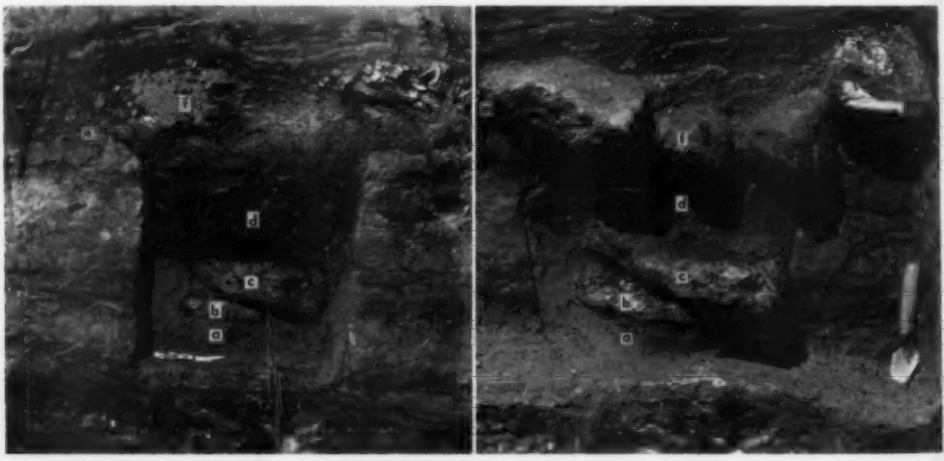

Fig 11. Cremation 42, Pit 7. *a*, silt; *b*, pocket of burnt bones; *c*, cap stone; *d*, carbonaceous material with some cremated bone; *e*, surface from which cremation pit was dug; *f*, cover rocks.

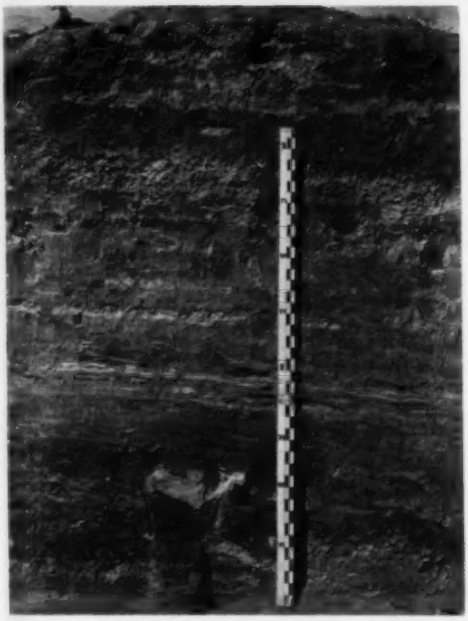

FIG. 12. Cremation 36, deposited in a pit dug during formation of Bed C-3. More than 2 m. of alluvial material was deposited over it.

Since the cremating was apparently not done in the pits where the bones were found, it is possible to speculate whether it took place in the valley or on the mesa top. If the crematories were on top of the lava-capped mesas, the soil matrix would expectably be red basalt-derived clay, and basalt pebbles might occur as inclusions rather than those of tuff because geologically the tuff beds are below the basalt flows. Cremation on the floor of the valley, however, would produce the gray clay-silt matrix noted. This matrix was probably derived from Bed D if the crematory pits were scraped out deeply enough to penetrate it. The material from this bed may have been gathered up with the bones when they were collected; or the matrix may also have been derived from the fine silt of Bed C, discolored by wood ash. Rounded tuff pebbles are present in both of these beds. These pebbles were noted with all but three of the bone lots, and in at least 4 cases the pebbles appeared to have been scorched by fire. This situation hints at the possibility that the campsite of these people was on the valley floor and may now lie deeply buried. But whether this was far or near from the place of our excavations is unknown.

Amount and Condition of Bones. The bone residue in any one cremation varies in amount from a few scraps to a double handful. In all cases this is far less than the normal amount of cremated bone coming from the funerary jars of the 14th century from Arizona W:10:50, the largest pueblo site of the area, where extensive studies have been conducted during the past 10 years. In the condition of the bones a similar contrast exists. The Cienega Creek site bone is finely broken, much of it literally reduced to bone meal, and seldom are individual pieces as much as 3 cm. long, while in later cremations pieces up to 10 cm. are not uncommon and many fragments are identifiable as to the specific element in the skeleton. The Cienega Creek material is extremely friable in its present state, possibly a result of its long burial, and is white to gray in color. The larger pieces show thermal cracks.

In part, the difference may be due to greater destruction of the bone by fire in the earlier cremations, hinting at higher temperatures. Other factors, however, may be involved. Experimental incineration of human bone in connection with medico-legal studies (Krogman 1949:89) has indicated that, given favorable circumstances, complete destruction of the human body by fire is possible with a heat of 2500°F(+). But to achieve this the bones must be brought from the edges to the core or maximum heat center of the fire, and when

FIG. 13. Cremation 39 (in Pit 3) and associated artifacts: unburned bone circlet and (?) deer legbone fragment near ends of pencil; projectile points, blades, and lump of red paint (above tip of large point).

calcined the bones must be agitated or struck for fragmentation and eventual complete disintegration.

There is little likelihood that we can reconstruct accurately the degree of heat reached in the Cienega cremations, the nature of combustible materials used, or to what extent draft conditions were employed. An obsidian point (Fig. 17 *w*) which passed through the fire was heated sufficiently to cause the obsidian to bubble and lose its form. George H. Roseveare, metallurgist of the Arizona Bureau of Mines, tested an obsidian chip from Pit 3 by using a thermocouple in an assay furnace muffle. He determined that incipient fusion was started in the obsidian at about 800° C (1472° F). It may be inferred therefore that temperatures of at least this magnitude were achieved. But the high fragmentation and nearly complete calcination of the bones suggests that 1472° F may have been below the actual heat developed. It is doubtful if long exposure to a low temperature fire could produce this effect. Agitation of the brittle bones during firing may account for the extreme fragmentation. Further fracturing would result from sifting the bones from the organic fuel ashes, and from their transportation from the crematorium to the final resting place. It could also be that intentional pulverizing was practiced. One may rule out postburial conditions such as the weight of the overlying stone and soil, frost action, chemical decomposition, and the removal of the bones from the ground by the archaeologist as the primary cause for break-up. The significance of these characteristics of the Cienega Creek cremations may now seem trivial, but contrasted with the late cremations, they suggest some difference in cremation practice beyond the normal fracturing effects of heat.

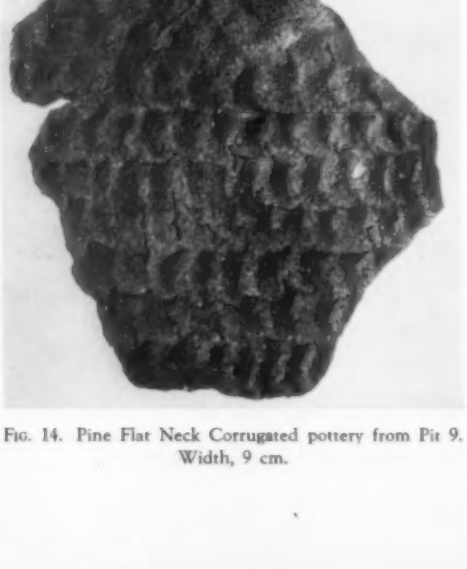

FIG. 14. Pine Flat Neck Corrugated pottery from Pit 9. Width, 9 cm.

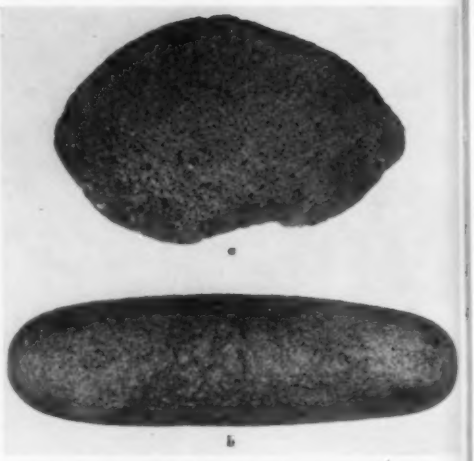

FIG. 15. *a*, stone tray of basalt; *b*, pestle of quartzite from Pit 3, Bed C-2. Length of *a*, 29.5 cm.

One further question seems answerable: Were the dead incinerated in the flesh or were the bones defleshed and dried before burning? Raymond S. Baby, of the Ohio State Museum, studied samples of the cremations and concluded that the former alternative was the preferred one. We do not know, however, whether dismemberment of the bodies, as practiced among the Hopewell people (Baby 1954), was the custom here.

Curiously, each of 2 cremation lots yielded a single unburned chip of a tooth crown and in one instance a single bone fragment also not burned. These are attributed to accident rather than to some regular custom related to the crematory process.

Identification of Bone Fragments. The separation of the bones from the matrix in the laboratory was not a simple task. When moist and still in the ground the bones had a putty-like consistency; when dry they were extremely brittle. After some experimentation, tedious manual cleaning was found best suited for removal of the larger pieces. At best, the larger

pieces, seldom more than 3 cm. long, constituted relatively poor samples for critical identification.

To overrule any possibility that the bones may have been of animals other than man, a careful analysis was made of each lot to identify human elements. In 44 of the 47 samples specific human identification was possible. Recognizable units included skull and jaw fragments, parts of long bones, phalanges, tooth roots, and bits of tooth crowns. It may be inferred that the 3 cremations which produced too small a quantity of bone residue for the observation of recognizable parts were also human. In no case was duplication of diagnostic bones seen and it may be further assumed that the cremations were of single individuals and not multiple.

The extensive fragmentation of the bones reduced the opportunity to determine the age of the individuals at the time of death to little more than guesses. No infant remains were observed and the chances of survival of these would be limited; 8 ash lots appeared to be youths, and the rest were listed as adults, presumably ranging from young to old. Evidently the practice of cremation among the people responsible for these finds was not age limited and there is no way of telling whether or not the custom was restricted by sex.

Small calcined fragments of distinctly nonhuman bones were seen among the ashes of 6 cremations: a fragment of deer antler, a piece of leg bone probably of deer, 2 artificially tapered bits of solid bone resembling awl points, and several minute sections of leg bones of small animals. Since we know that some of the stone tools and pipes were subjected to the firing, one may suppose that other artifacts, represented by these fragments, were included too.

Artifacts Associated with the Cremations. Material goods of several kinds accompanied about half of the cremations. All of these objects, except the basketry with Cremation 45, were resistant to both time and fire. Perishable cultural items undoubtedly also accompanied the dead but these were consumed by the flames or destroyed by time.

Table 1 gives both the range of objects recovered and the particular associations of types of specimens with any one cremation. Most frequent were projectile points, 35 in all and ranging from one to five in individual cremation associations. Generally these were in the bone mass but near the upper part, as though they were added after most of the bones had been deposited in the earth. This is well illustrated in Cremation 39, where in addition to points, several blades were tucked in edgewise along the fringe of the bones as were also a lump of paint and 2 unburned bones, probably artifacts (Fig. 13). Chips of chert and obsidian appear to have been fragments of artifacts, thermally fractured. No shell fragments or jewelry were observed.

There is no discernible correlation between the kind of object included with the dead and the age of the individual. Projectile points appear with all ages, though the difficulty of aging except broadly has already been pointed out.

Some of the artifacts passed through the crematory fire, whereas others did not. Projectile point *w* in Figure 17 was heated sufficiently to develop bubbles; a few chert points reveal thermal fracturing and two of the 3 complete pipes also evidence exposure to heat. Most of the material, however, appears to have escaped the ruinous effects of the fire. Why these 2 methods prevailed is, of course, not known.

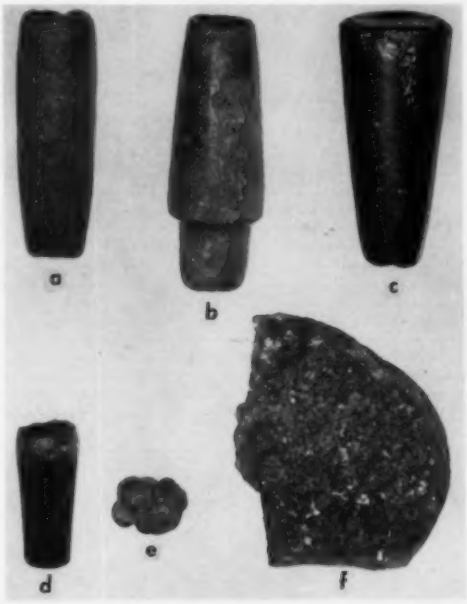

FIG. 16. *a-d*, pipes; *e*, *f*, miscellaneous stones associated with cremations, Pit 3, Bed C-2. Length of *b*, 5.9 cm.

TABLE 1. ARTIFACTS ASSOCIATED WITH CREMATIONS AT CIENEGA CREEK SITE.

CREMATION NUMBER	AGE		STONE ARTIFACTS								MISC. STONE					BONE PROB. TOOLS	
	Youth	Adult	Proj. Points	Blades	Obsid. Disc	Side Scraper	Obsid. and Chert Chips	Pipes	Pestle	Tray	Worked Schist	Concretions	Chalcedony Concretions	Basket	Red Paint	Burned	Not Burned
1	x																
2		x															
3		x	1														
4		x															
5		x	1	2													
6		x	2	2									x			x	
7		x					x										
8		x	1							x							
9		x	4														
10		x	4												x		
11		x					x										
12		x					x										
13		x															
14		x	3					x									
15		x			x											x	
16	x																
17		x															
18		x															
19		x					x										
20	x																
21		x															
22		x															
23		x															
24	x																
25		x	1					x									
26		x	1														
27		x															
28		?															
29		x					x										
30		x															
31		x	2				x										
32		x															
33		x															
34		x	1														
35	x															x	
36		x					x										
37	x		1	1			x					x				x	
38		x									x						
39		x	5	2											x		2
40		x															
41		x															
42		x						x									
43	x		2														
44	x																
45		x	3											x			
46		x	1	1													
47		x															
Pit 3 Misc.			2	2		x		x	x						x		

It should be observed that the same situation holds true for Hohokam cremations of later times, although in them most of the accompanying material was subjected to the fire.

It seems clear enough that, for the cultural stage represented and for the people known only by this limited material, cremation of the dead, the deposition of the bones in a limited area, and the accompaniment of earthly goods ranging from projectile points to "charm stones" (concretions), were well established customs of the day.

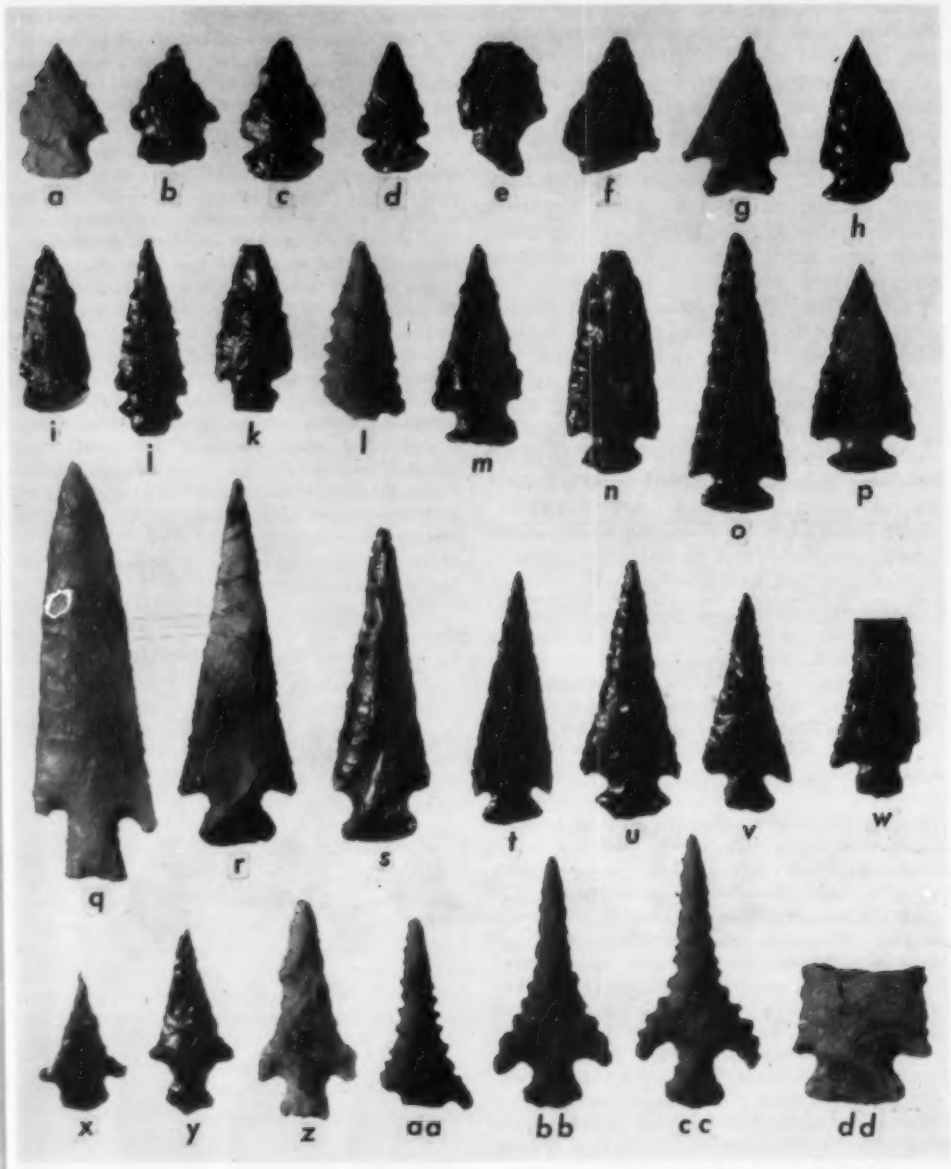

FIG. 17. Projectile points associated with cremations, Pit 3, Bed C-2 (except *a*, from surface). Length of *q*, 8.4 cm.

Cultural Materials

Before continuing with the examination of the artifacts, it should be emphasized that at least that part of the Cienega Creek site exposed by the excavation is not regarded as a habitation area. Even though there was evidence of some food preparation in the form of grinding tools, hearths, and hearthstones (principally Bed D-1) there was little wastage from stone chipping and no bone refuse whatever. It seems rather to have been a watering place where some foods requiring the use of water were prepared and where, due to a special attraction not understood, the incinerated bones of the deceased were placed. The materials discussed below, therefore, while no doubt typical enough of the culture of the people who produced them, have been functionally selected. Search for the village or habitation site has proved fruitless and in all probability it lies deeply buried under a mantle of earth. If the camp is ever found, a comparison of the objects from the day-to-day trash deposit with these from the cremations should manifest few direct relationships.

Surface: As previously noted some stone chips occurred on the surface of the arroyo slopes and provided one of the clues of the presence of cultural material. During the course of the work, one whole and one fragmentary point were also found. The former (Fig. 17 *a*) was at a level below the D bed and had probably eroded from it. It is interesting chiefly because it closely resembles the projectile point (Fig. 22 *a*) recovered from this bed in the excavation.

Bed A: Sterile within the area explored; probably contains some pottery of late prehistoric times, from the nearby site (Ariz.W:10:4) which was occupied about 1300, or from older horizons.

Beds B-1, B-2: Potsherds only, occurring chiefly towards the north end of the excavation and in the upper part of the sediments of Pit 4, throughout the silt fills of Pits 9 and 10, and in an old excavation younger than Pit 10 but older than Pit 9 (Fig. 9, deposit shown as black clay).

Of the 59 pieces recovered directly in B-1, 48 are from redware vessels (14 bowls, 34 jars), 6 are plain brownware, and one is from a mica schist tempered vessel originating among the Hohokam. The redware, made during more than a thousand years in the Point of Pines region, exhibits only subtle differences and for that reason is not readily placeable as to time. However, by paste, color, finish, and vessel forms, these fragments match the Reserve Red (James Gifford, report in preparation) of about A.D. 1000. Four fragments of a distinctive neck-corrugated vessel, as exemplified in Figure 14, (Pine Flat Neck Corrugated, Breternitz 1956:36-9) also aid in this time identification. The eroded condition of the Hohokam fragment prevents placement as to phase but the above age is not out of reason. Six sherds from the upper fill of Pit 4 are also redware and all are jar fragments. Pits 9, 10, and the intermediate area produced a further sample of 55 sherds, predominantly redware but including also good examples of Pine Flat Neck Corrugated. The pottery sample from all sources represents a typological as well as a stratigraphical unit assignable to the Reserve phase.

The B-1, B-2 distinction was only locally discernible and both beds actually represent a single alluvial stage. The significance, of course, is that Bed B was formed and Pits 4, 9, and 10 became filled at about the time this pottery was produced. Pit 4 was dug by pottery-using people from the C-1 surface, and Pits 9 and 10 were penetrations from the B-2 surface. The pottery fragments we have are evidently of vessels used in gathering and transporting water. The study of walk-in wells near Point of Pines (Wheat 1952:194) has brought out the fact that redware was preferred for this activity and that sherds of it predominate about the water holes. The evident reason is that the slipping and polishing of surfaces rendered the vessels less pervious and hence better suited for water transport and storage than the more porous brown and corrugated wares.

Bed C-1: Sterile; however, Pit 2 shows human activity during its formation.

Bed C-2: Within the formation itself there were a few scattered chert and obsidian flakes, useful only in revealing that some tool dressing was done nearby. Also noted were a few fragments of unshaped lava blocks which had served as grinding stones. At the termination of C-2, Pits 3 and 5 were made. Of these the former holds special interest because of the artifacts which were recovered as cremation accompaniments. This was, in fact,

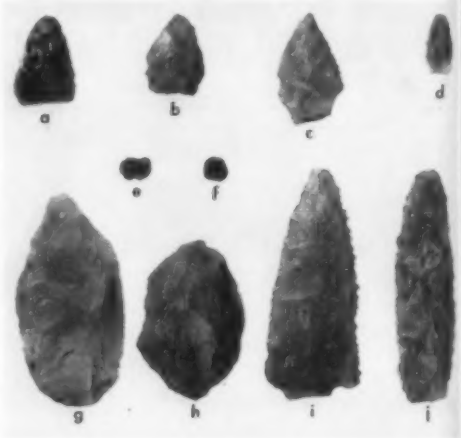

Fig. 18. Blades and miscellaneous stone objects from Pit 3, Bed C-2. Length of *i*, 9.1 cm.

the chief source of specimens from the site. The inventory follows (identification of material by Arizona Bureau of Mines):

Tray (Fig. 15 *a*): Vesicular basalt; petal-shaped, depressed basin 1 cm. deep, edged with a low rim; central part worn smooth from grinding; length 24 cm., thickness 2.5 cm.

Pestle (Fig. 15 *b*): Quartzite; dressed to form by pecking; both ends well rounded from use; length 29.5 cm.

Pipes (Fig. 16 *a-d*): *a*, basic dike rock, altered; tubular, with slight taper; bore expands from 0.9 to 1.1 cm. from bit to bowl end; burned; length 5.5 cm. *b*, materials as in *a* above; tapered and shouldered to produce small bit; bore diameter at bit end 1.1 cm., at bowl end 1.3 cm.; burned; length 5.9 cm. *c*, serpentine; reworked part of larger pipe; broad and roughly finished; pronounced taper towards bit; bore diameter 0.8 cm.; not burned; length 5.3 cm. *d*, serpentine; bit element of composite pipe; original bowl probably stone or wood; tapered, expanded end roughened for cementing to bowl; bore expands from 0.7 cm. to 1.1 cm.; not burned; length 3 cm. Pipes, either ceramic or stone, have not been recognized as one of the hallmarks of Hohokam; but they do appear in early villages of the Mogollon culture. The 3 forms in stone represented by the specimens from the Cienega Creek site have equivalents in pottery times (See Fig. 25).

Spherulite (Fig. 16 *e*): Burned.

Stone Flake (Fig. 16 *f*): Mica schist; thickness 0.3 cm.; edges trimmed; material foreign to area.

Projectile Points (Fig. 17, all except *a*): Frequency of materials, in order named: obsidian, chert, chalcedony, and jasper; form patterns represented: (1) short broad type (*b-i*) grading to (2) long tapered form (*j-w*), some with serrations; (3) slim tapered point with flared tangs (*x-cc*) some with pronounced serrations. Typologically Group 1 appears to derive from the Chiricahua style point (Sayles and Antevs 1941, Pl. 11; Martin, Rinaldo, and Antevs 1949, Fig. 17 *b*) and to persist into the early Mogollon Circle Prairie phase of Point of Pines (Wheat 1954, Fig. 54). Group 2 establishes the pattern of the long tapered Hohokam points but is not specifically analogous (Gladwin and others 1937, Pls. 75-91). Regionally Group 3 is represented by early points in Hohokam (Gladwin and others 1937, Pl. 94 *g*) and from Cordova Cave (Martin and others 1952, Fig. 49 *l*). Specimen *dd* (Fig. 17), in size and blade pattern, suggests derivation from the San Pedro Stage type of Cochise (Haury 1950, Pl. 22) and may have been the inspiration for the long tapered points of Group 2.

Blades (Fig. 18 *a-c, g-h, j*): Mostly chert, some obsidian; workmanship rough; length from 3.1 to 8.4 cm.

Knife-saw (Fig. 18 *i*): Chert; stem broken, one edge sharply serrated; length 9.1 cm.

Worked Flake (Fig. 18 *d*): Paper-thin flake of fine-grained stone; edges chipped, possibly to simulate projectile point; burned; length 2.3 cm.

Bilobate Object (Fig. 18 *e*): Obsidian; chipped to form; length 1.2 cm.

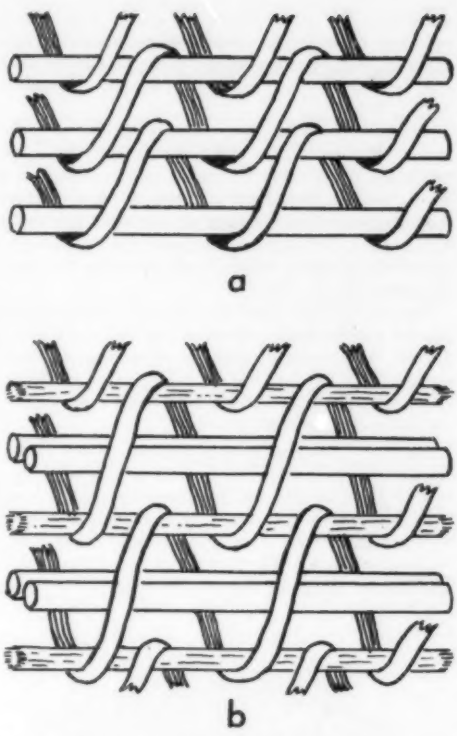

FIG. 19. Coiling techniques in basketry with Cremation 45. *a*, 1-rod foundation; *b*, 2-rod-and-bundle foundation.

Disc (Fig. 18 *f*): Obsidian; originally chipped; faces and edge ground; diameter 1 cm.

Bed C-3: Stone: Only a few random flakes, hearthstones (one whole), and several grinding stone fragments. The metate and handstone which first marked the site (Fig. 2) were in this bed. The netherstone of the pair was a wedge-shaped lava block, not intentionally shaped, but 35 cm. square in plan. The surface bore evidence of light use only. The handstone, likewise unshaped, was also of lava about 12 cm. in diameter with a single worn face.

Basketry: Cremation 45 (Fig. 9) was deposited some time during the formation of the C-3 bed. Remnants of 2 coiled baskets were associated with it and one of these, although resting on its side, contained some of the human ashes. Preservation of the fragments was accomplished by direct transfer from the wet ground to water in which they were carefully cleaned with a soft brush; then they were given successive baths of acetone and finally extended immersion (several days) in a gasoline-paraffin mixture. Upon drying the fragments were solid enough for handling. Some shrinkage took place.

The largest fragment, half of the original specimen, represents a bowl-shaped basket about 20 to 25 cm. in

diameter. The other pieces are small. Both baskets exhibited close coiling, simple uninterlocked stitching, and a self rim, but they differed in the foundation structure (see Morris and Burgh 1941 for basketry terminology).

The first type is 1-rod foundation (Fig. 19 *a*) with fine texture of about 3 coils and 6 stitches per centimeter. Morris and Burgh (1941:11) list this type as infrequent in the Anasazi territory, dated to Pueblo III when it occurs, although interlocked stitching on the same foundation is common. The technique appears to have been one of the more prevalent forms of basketry among the Desert Hohokam (Haury 1950:405).

The second type (Figs. 19 *b*, 20) is 2-rod-and-bundle foundation; bunched; texture is fine, 2.5 coils and 4 stitches per centimeter. Perhaps no basketry technique was ever so widely used and for so long a time as this one in the Southwest. In Basketmaker times it predominated (Morris and Burgh 1941:13).

Bed D-1: Although most productive of hearths and hearthstones, and most heavily impregnated with charcoal, Bed D-1 yielded few formalized artifacts. Wastage from tool fashioning in the form of chert and obsidian flakes was present but infrequent (about 30 flakes in all).

Grinding Stones: The 2 complete and 2 fragmentary netherstones share the characteristics of similar stones noted from the higher beds, that is, irregular unshaped blocks of lava, selected for one flat surface on which work could be done. Maximum dimensions range up to 40 cm. These specimens show a complete lack of attention to form and only one shows use extensive enough to produce a basin of any depth.

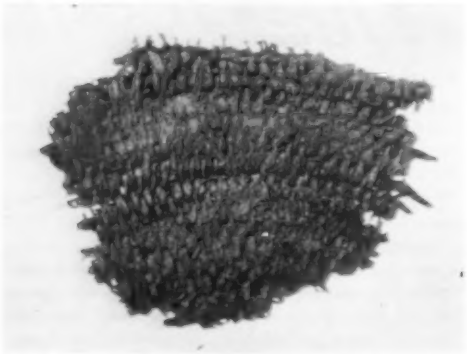

FIG. 20. Basketry fragment from Cremation 45. Actual size

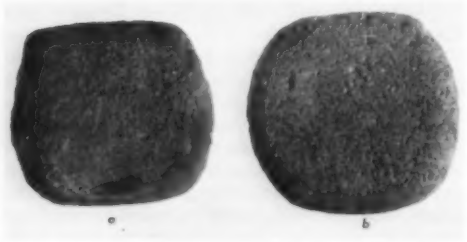

FIG. 21. Handstones from Bed D-1. Maximum diameter of *a*, 11 cm.

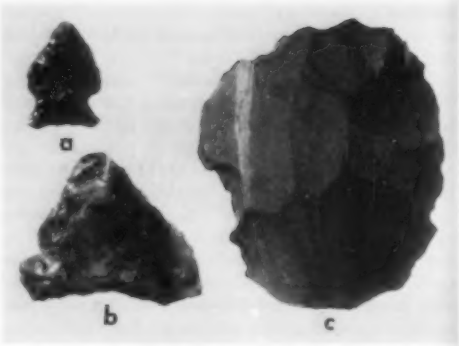

FIG. 22. Tools from Bed D-1. Maximum diameter of *c*, 6 cm.

Two handstones (Fig. 21) of diabase and dacite are bifacial and show edge dressing by pecking to give them symmetry. Maximum diameters are 11 cm. They come within the range of handstone types usually associated with the Chiricahua stage of the Cochise culture.

Projectile Point (Fig. 22 *a*): Obsidian; length 2.2 cm. This type is a trait of the Chiricahua stage.

Scrapers (Fig. 22 *b*, *c*): Chert and quartzite; too few scrapers were recovered to establish types. Specimen *b* is plano-convex in section and the lower edge is steeply chipped to produce a gougelike edge. The other specimen is a roughly dressed primary flake.

Bed D-2: Sterile.

Bed E: Sterile.

RECAPITULATION, DATING, AND RELATIONSHIPS

Figure 23 is presented as a means of recapitulating the evidence and as an attempt to reconstruct the geological and cultural history of the Cienega Creek site. The features have been rearranged geographically to emphasize the continuity; the vertical scale has been exaggerated for convenience in drawing. Areas marked "Old Surfaces" represent pauses in the alluvial process of sufficient duration to produce a definable surface, either by slight erosion or by exposure and trampling.

The Age of the Deposits. We have already seen that geology alone does not yield the answer to the age of the cultural materials in terms of elapsed time. It does, however, vividly establish the stratigraphic order, and

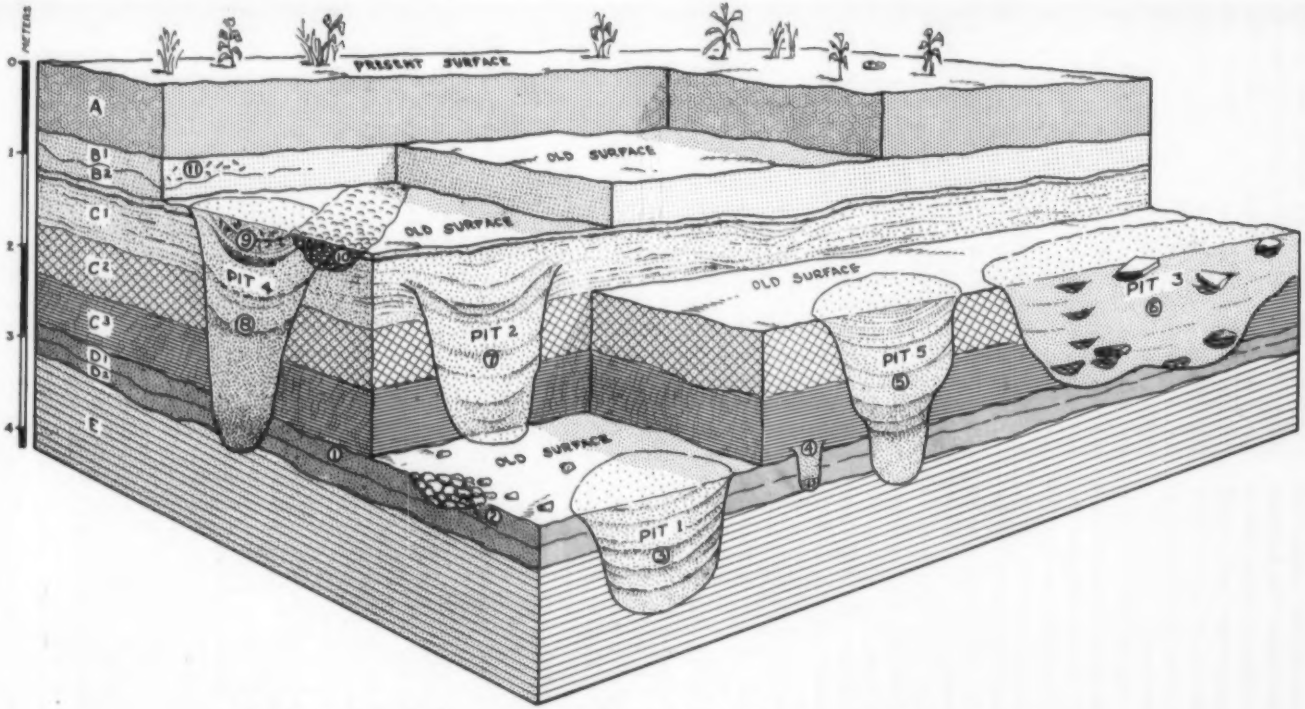

FIG. 23. Block diagram summarizing the sequence of cultural features in the Cienega Creek site in relation to the geological stratigraphy.

THE BEDS:

A. Recent silt and sand; sterile within area of excavation; dark brown.
B-1, B-2. Sand and silt, some gravel; light brown; only locally separable into 2 strata.
C-1. Finely laminated sands and silts; soft; variable color; some eroding of surface.
C-2. Silty clay with many tuff pebbles; gray; hard; no apparent structure.
C-3. Irregularly lensed sands and silts; variable color; soft.
D-1. Clay; dark gray to black; much carbon from fires; culture.
D-2. Clay; dark gray; no charcoal or culture.
E. Lensed sands and gravels.

THE FEATURES: (ARRANGED IN SEQUENTIAL ORDER):

1. Culture-bearing layer; much charcoal, hearthstones; old walking surface apparent.
2. Hearth.
3. Pit dug by man during this stage of valley floor use.
4. Pit cremation (No. 36) early in period of C-3 layer formation.
5. Pit excavated at terminal C-2 stage from short-lived surface.
6. Large pit containing 40 concentrations of cremated human bone, terminal C-2.
7. Pit dug during formation of C-1.
8. Pit dug from old surface, after formation of C-1.
9. Potsherds high in alluvial fill of pit.
10. Small gravel-laden erosion channel, postdating filling of Pit 4.
11. Potsherds in B-1.

therefore the relative age, of the various features of the Cienega Creek site. The archaeological specimens, other than pottery, are of only nominal help because some are of such generalized form that they are not critical horizon markers, and others, as some of the projectile point types, are known only from rather late deposits, too late, it would seem, to correlate satisfactorily the situation at hand. The botanical approach, as a clue to different ecological conditions, also has failed, in that the specific identification of charcoal (by T. L. Smiley, Laboratory of Tree-Ring Research, University of Arizona) shows only existing species. As of this writing the results of pollen studies have not become available. The main recourse, then, is pottery as a medium for setting certain limits, and radiocarbon dating for which, fortunately, there was sufficient material from several of the beds to permit a series of assays.

Pottery. As previously noted, the pottery, chiefly Reserve Red and the more diagnostic Pine Flat Neck Corrugated, in Bed B-1 and in the fills of Pits 4, 9, and 10 is believed to be approximately 1000 years old. The inference may be drawn from this that the surface of C-1 is that old or somewhat older but probably not much younger. From Bed C-1 downward through the succession of beds, pottery was absent and the deposits may be judged to be of prepottery age. Martin (Martin and others 1952: 483) has listed a radiocarbon date of "150 ± 160 B.C." (Sample C-585) for the beginning of the Pine Lawn phase (Tularosa Cave) in New Mexico, some 75 air miles northeast of the Cienega Creek site. This is the earliest date thus far obtained for a pottery producing horizon. If we accept this as the time of appearance of pottery in the region, an age in excess of 2000 years is assignable to

TABLE 2. RADIOCARBON DETERMINATIONS FOR CIENEGA CREEK SITE.

Description	*U.A. Sample No.*	*Age (yrs.)*	*U.M. Sample No.*	*Age (yrs.)*
Fragmented charcoal of pine and oak from hearth in Bed D-1	19	4310 ± 160	M-541	2530 ± 300
Charcoal, highly fragmented; distributed through matrix of Bed D-1 about 2 m. east of Pit 3; 2 field samples from a 3 m. area combined	21 & 22	3980 ± 160	M-540	2400 ± 200
Fragmented solid charcoal from fill of Pit 6, dug from surface of Bed D-1	27	3070 ± 150		
Finely divided carbonaceous material associated with cremations in Pit 3, Bed C-2	28	2515 ± 300		
Charcoal, scattered fragments, 2 m. north of Pit 3 and near a hearth in Bed D-1	29	4400 ± 150		
Scattered fragments of charcoal from Bed D-1 adjacent to U.A. Samples 21 and 22 (M-540) above			M-461	2600 ± 250
Fragmented solid charcoal from matrix of Pit 3, Bed C-2; distributed between cremations; may be from crematory fires, brought to this location with the ashes			M-462*	1140 ± 300
Finely pulverized charcoal, mixed with some burned bones and soil; from Pit 7, Cremation 42 (Fig. 11 *d*). Although in Bed C-3, Pit 7 was made from C-2 surface	48	2150 ± 200‡		
Wood, partly rotted, water saturated; from Bed C-3 near Pit 8 (2 runs)	49 53	2610 ± 200 2080 ± 200‡		
		Average 2345 ± 175		
Same sample as above, new burn	51	3380 ± 200		
Six-pound chunk of wood slightly charred, saturated with pitch, very wet; from fill of Pit 8 (2 runs)	50 52	3250 ± 200‡ 3025 ± 200		
		Average 3135 ± 175		

* This was a small sample and the results are not regarded as having the same validity as the other dates.
‡ Samples adequate but assay regarded as grade B.

C-1 and the formations below. This assessment is consistent with the data provided by radiocarbon analyses made in the laboratory at the University of Arizona.

Radiocarbon. Radiocarbon determinations were obtained from 2 sources, the University of Arizona Carbon-14 Age Determination Laboratory and the University of Michigan Memorial Phoenix Project Radiocarbon Laboratory. The former employs the carbon-black method, the latter the gas-sample technique. The year of assay is 1956. All samples have been subjected to varying amounts of ground moisture.

To aid the discussion of the results obtained (see Table 2) from the 2 laboratories, a visual summary is given in Figure 24. It is immediately evident that while the dates from each laboratory are consistent on the whole with the stratigraphy of the site, there is a marked discrepancy in the values. Obviously, both sets of dates cannot be correct and it is even possible that neither set of dates is an accurate reflection of the true age. This statement may impress some as a rebel attitude but it is a way of indicating my own distrust and suspicion of the validity of many of the radiocarbon dates that have been released in recent years. The perplexing situation here underscores the fact that blind acceptance of radiocarbon analyses has led to irresolvable complications in our attempts to construct cultural chronologies. While there is no intent to belittle the technique itself, or the work of either laboratory concerned here, attention must be called to our still elementary understanding of such problems as contamination, the relative merits of solid-carbon versus the gas-sample methods, possible differences in results from various laboratories arising from conditions peculiar to a laboratory, the question of association of sample and cultural horizon, and more broadly still, the strictures and cautions that ought to be applied in the area of interpretation.

Turning to the present problem: by averaging the results of samples from Bed D which were measured by both laboratories (19 and M-541; 21, 22 and M-540), we have values of 4145 versus 2465 (sigma ignored). This is so large a discrepancy, considering the small number of years involved, that markedly different interpretive results would follow if one or the other date were used. The question of differences in laboratory techniques and their effects on the results must be left to the chemist and the physicist to solve. The only means the archaeologist has to evaluate the 2 sets of dates

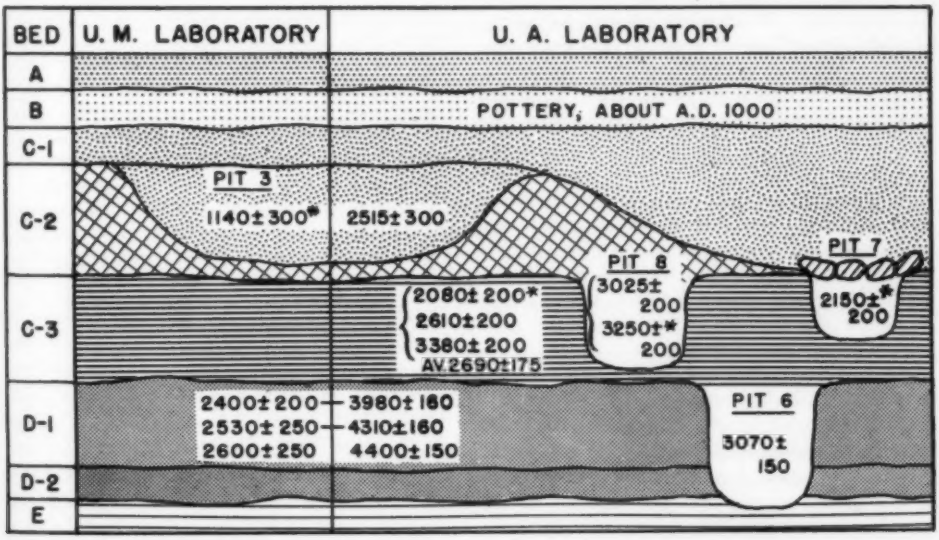

FIG. 24. Comparative radiocarbon results from the University of Michigan and University of Arizona laboratories. Years are B.P. Asterisks denote assays of grade *B* quality; brackets indicate different assays of same sample in the University of Arizona laboratory; dashes between dates represent assays of the same sample by both laboratories.

is to introduce supporting information in search of reinforcement for his inclination to pick one set of dates over the other.

On the strength of the following information, the older values for the features of the site are favored:

1. The implement complex in the oldest culture-bearing bed (D-1) is that of the Chiricahua stage, though admittedly the identification had to be made on only a few traits. This complex in southeastern Arizona has been dated at 4006 ± 270 B.P. (Libby 1955: 113) and in west-central New Mexico as 4508 ± 680 B.P. (Libby 1955: 113; Martin and others 1952: 483). The 3-assay average for the Cienega Creek site from the University of Arizona Laboratory is 4230 ± 105 B.P. The consistency of these dates tends to develop confidence in their validity.

2. The C layer with its 3 component parts, on the physical evidence of the stratigraphic column and the local archaeological pattern, has been judged to be of prepottery age, before A.D. 1 or 150 B.C. if Martin's (Martin and others 1952: 483) introductory date for pottery in nearby New Mexico is accepted. The dates therefore of 2515 ± 300 B.P. for Pit 3 with its cremations and the slightly earlier values for Pit 8, Bed C-3, and Pit 6 are consistent with this reasoning. On the other hand the Michigan laboratory date of 1140 ± 300 years ago, or about 9th century A.D., for Pit 3 cannot be reconciled with the local archaeology. This substantiates Professor Crane's opinion that the date procured is not satisfactory. By that time pottery was well established, earth burial rather than cremation was the rule, and the projectile point and pipe types were not those of the artifacts associated with the cremations (Bretternitz 1956). The pottery of Bed B, well above Bed C-2, represents the classes of ceramics expectable as the normal accompaniment for a 9th to 10th century artifact complex.

Ages of approximately 4000 years for Bed D-1, the Chiricahua stage, and 2500 years for Bed C, the time of the cremations, are supportable by collateral evidence.

It will be seen that a minor inconsistency in the values of the dates in relation to the stratigraphy occurs between Pit 8 and Bed C-3. Pit 8 is obviously more recent than the bed into which it was cut. The dates, however, indicate an inversion of a minor order. The 3 runs (49, 51, and 53) of the same sample from Bed C-3 gave a disturbing range from 2080 ± 200 to 3380 ± 200, a spread which hints at contamination or instrumentation problems. The sample from Pit 8, a chunk of pitch pine, had ideal survival properties and it is not impossible that it lay on the forest floor for many decades before being gathered for fuel. No satisfactory explanation is apparent to account for the discrepancy. It is evident, however, that radiocarbon will not always produce consistent results where narrow time limits are involved and where the organic material itself has been so excessively exposed to ground moisture.

The prehistoric wells reported in the Clovis-Portales area, New Mexico, (Evans 1951) are strikingly similar to those on Cienega Creek in their general configuration. Evans estimates the age of these wells to be later than the Folsom complex and ". . . considerably earlier than the late prehistoric Indian horizons of the region" (1951: 8). In the Arizona occurrence well-digging was practiced over a long period of time, even by Indians of late prehistory; but the older wells, and those of New Mexico, would appear to be of roughly comparable age.

Correlation of Artifact Complex. A few suggestions as to possible linkages for the most definitive elements have already been made. Viewing the complex as a whole, it appears that typological connections with 2 later cultural forms, Hohokam and Mogollon, may be established. This is represented visually in Figure 25. Temporally, the Cienega Creek complex associated with the cremations is late in terms of the entire Cochise culture development and it may properly be recognized as a part of it, that is, late San Pedro stage. It thus stands in the right time relationship to both Hohokam and Mogollon to have contributed to these later complexes.

Two projectile point traditions, based on form, are evident and these perhaps had separate origins. The first is a long, tapered style, traceable to the kind of point that characterized the San Pedro stage and which appears to have given rise to the more elaborate forms associated with the Hohokam. The second is a short stubby point which is seen first in the Chiricahua stage and which survived into pottery times among the Mogollon people. These 2 traditions coexisted in the time horizon of Pit 3, or about 500 B.C. and subsequently developed

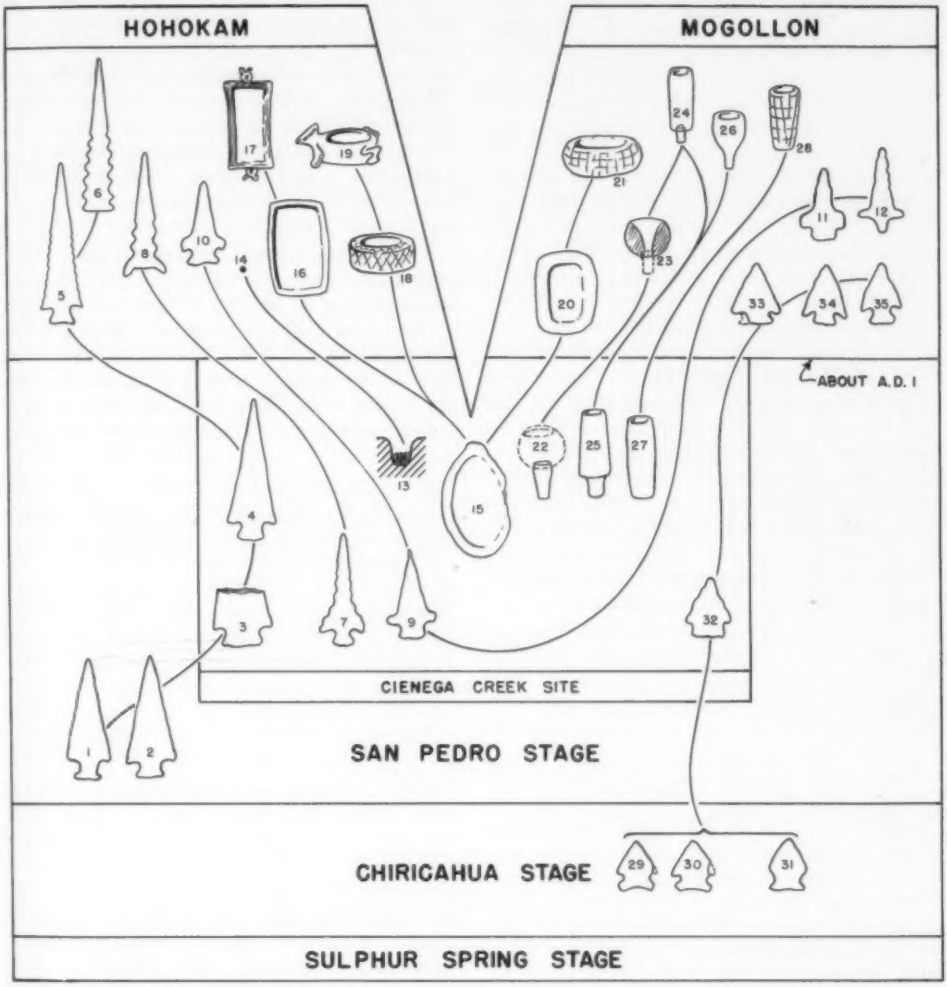

FIG. 25. Suggested relationships of the main components of the Cienega Creek site with comparable elements of later Hohokam and Mogollon complexes. Derivations of projectile point traditions in stages of the Cochise culture are also indicated. Objects not drawn to scale.

1. Sayles and Antevs 1941, Pl. 16 *d*.
2. Haury 1950, Fig. 64 *d*.
3. Cremation 37, Cienega Creek site (A-16,047).
4. Cremation 26, Cienega Creek site (A-16,006).
5. Gladwin and others 1937, Pl. 87 *b*.
6. Gladwin and others 1937, Pl. 89 *a* (*right*).
7. Cremation 39, Cienega Creek site (A-16,045).
8. Gladwin and others 1937, Pl. 89 *c*.
9. Cremation 10, Cienega Creek site (A-15,851).
10. Gladwin and others 1937, Pl. 94 *g*.
11. Martin and others 1952, Fig. 49 *l*.
12. Haury 1936, Pl. 18 *f*.
13. Pit Cremations 36 and 42, Cienega Creek site.
14. Gladwin and others 1937, Fig. 39, *2*.
15. Stone tray, Cremation 8, Cienega Creek site (A-15,905).
16. Gladwin and others 1937, Pl. 97 *c*.
17. Gladwin and others 1937, Pl. 97 *e*.
18. Gladwin and others 1937, Pl. 58 *c*.
19. Gladwin and others 1937, Pl. 71 *b*.
20. Wheat 1954, Fig. 44 *b*.
21. Haury 1936, Pl. 15 *f*.
22. Pit 3, exact cremation association uncertain, Cienega Creek site (A-15,904).
23. Haury 1936, Pl. 15 *c*.
24. Martin and others 1952, Fig. 44 *lower right*.
25. Cremation 14, Cienega Creek site (A-15,872).
26. Wheat 1954, Fig. 37.
27. Cremation 25, Cienega Creek site (A-16-008).
28. Wheat 1954, Fig. 52 *g*.
29. Sayles and Antevs 1941, Pl. 11 *c*.
30. Martin, Rinaldo, and Antevs 1949, Fig. 17 *b*.
31. Bed D-1, Cienega Creek site (A-15,866).
32. Cremation 31, Cienega Creek site (A-16,010).
33. Wheat 1954, Fig. 54 *h*.
34. Martin and others 1952, Fig. 45 *l*.
35. Haury 1936, Pl. 17 *e*.

along different cultural paths. Neither tradition, however, survived locally as a dominant one after about A.D. 800. This divergence is supported by a few other elements too. The pit cremation practice with offerings is clearly ancestral to the early Hohokam mortuary custom. The stone tray is the probable forerunner of the Hohokam slab palette of the Pioneer period and also of the Mogollon stone disc. Stone pipes, both the unit and composite types, are not associated with early Gila Basin Hohokam, but they do occur with some frequency in Mogollon sites.

This interpretation is possibly best considered as an accommodation of the elements known from the Cienega Creek site at the present time. It is compatible, however, with the idea held by some (Haury 1943; Martin, Rinaldo, and Antevs 1949: 221; Martin and others 1952: 500-1) that the San Pedro stage complex was parental to both Hohokam and Mogollon. The present material adds somewhat greater specificity to tool types because those cited heretofore in favor of this continuity were of a generalized order. Furthermore, this constellation of elements, existing just before the appearance of pottery, eases to some extent the transition from no pottery to pottery. It indicates that some of the traits we have associated only with the oldest pottery horizons of the Hohokam and Mogollon actually had earlier beginnings.

One must express awareness that some analogies exist between the traits of Cienega Creek site and elements of the Archaic horizon of the eastern United States, for example, cremations, stone pipes, and projectile point similarities. But the body of data now available seems inadequate to explore further the meaning of these parallels (see also Jennings 1956: 98-9).

Summary and Conclusions.

1. Traces of human activity, consisting of hearths, pits dug for water, cremations, and artifacts occur at varying depths in a flood plain deposit.

2. Aggradation, which caused a raising of the absolute level of the valley floor, was interrupted by several brief pauses.

3. The ready identification of the formational units and the direct association of some of these with the human evidences permit the relative ordering of human activity by applying the stratigraphic principle.

4. Since the succession of beds is not referable to any known sequence, geology in itself does not provide primary data as to the magnitude of the time required for the formation of the deposits. Although dating clues must therefore be sought through other approaches, the absence of marked erosional unconformities suggests a post-Altithermal period of valley filling and a depositional history of comparatively short duration.

5. Radiocarbon dates from 2 laboratories have been obtained. These series of dates, while not consistent with respect to each other, for the most part are compatible in relation to the provenience of the samples in the stratigraphic column. For reasons previously outlined, the older dates are regarded as most closely reflecting the true ages of the respective deposits.

6. From this evidence it may be concluded that: (1) at about 2000 B.C., Cochise people first made use of the spot, digging for water and preparing food acquired by hunting and gathering. Beyond the few stone tools they left behind nothing is known about them from this site. (2) By about 500 B.C. people were still seeking water here by digging holes and in addition they were depositing the remains of their cremated dead on the site. Although the associated material items such as basketry, projectile points, pipes, paint, and "charms" indicate a higher level of cultural complexity than the tools in the older bed, pottery was absent from the complex. (3) By about A.D. 1000 pottery was left by later Mogollon-Pueblo occupants of the region who also sought water.

8. The typology of the artifacts in Bed D-1 equates with the Chiricahua stage of the Cochise culture.

9. The inventory of traits from Pit 3 (Bed C-2) has no direct temporal or typological equivalent elsewhere and the cremations are among the earliest occurrences of this custom in the Southwest.

10. The traits are divisible, however, into 2 clusters, namely: (1) cremations with offerings; long, tapered, often serrated, obliquely notched projectile points; paint; a stone tray, which is more closely allied to the Pioneer period of the Hohokam than to any other known complex, and (2) short, stubby points and stone pipes which are known in later Mogollon horizons. Furthermore, a few of the

elements, such as the large side notched point, grinding stone, and pestle, may be taken as survivals of the earlier San Pedro tradition.

11. The cultural material derived from the cremations may be viewed as ancestral Hohokam on the one hand, and Mogollon on the other hand, but not greatly antedating the oldest ceramic horizons of either. The origins of specific elements such as cremations and pipes are not known.

12. The radiocarbon date of about 500 B.C. for the potteryless assemblage of artifacts from Pit 3 and a date of 150 ± 160 B.C. for the earliest pottery horizon, the Pine Lawn phase of western New Mexico (Martin and others 1952: 483), narrow the time of appearance of this trait, in that part of the Southwest with which we are concerned, to perhaps the 2nd or 3rd century before Christ.

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UNIVERSITY OF ARIZONA
Tucson, Ariz.
January, 1957

POTTERY IN THE NORTHWEST

DOUGLAS OSBORNE

IN 1932 Verne F. Ray reported ethnographic data on the use of unfired pottery among the Sanpoil of the Plateau and discussed archaeological and ethnographic occurrences of both unfired and fired pottery in and adjacent to that area. He was disposed to look upon Sarci pottery as the most likely source for the Sanpoil trait.

Since that time there has been an accumulation of further finds of clay items from the region. Taken individually these bits of data are perhaps worthy of small recognition but, as a group, they are beginning to assume proportions which suggest that the use of unfired, partly fired, or fired clay for numerous purposes may have been a Plateau-wide trait. I shall report here on such items as are known to me and which have become available since Ray's paper. In addition to this a single piece of fired clay, a true potsherd, was found in 1956 in the collection of Harold Koethe of Battle Ground, Washington, by Alan Bryan, then a pipeline archaeologist. Bryan reports that the site, near the mouth of Salmon Creek, northwest of Vancouver, Cowlitz County, Washington, has seen a minimum of destructive digging and should be excavated. This sherd forms the main course as far as my factual offerings in this paper are concerned. I am grateful to Bryan for bringing the sherd to my attention. The photographs of the piece were done by E. F. Marten of the University of Washington Campus Studios (negatives 3605). My wife, Carolyn Osborne, enlarged the thinsection which was prepared for me through George E. Goodspeed.

Kutenai, Sanpoil, and Shoshone. Claude Schaeffer's valuable paper (1952) on Kutenai pottery adds data which Ray unfortunately lacked, although the latter lists the Kutenai as having pottery in a later publication (Ray 1942). The Kutenai potter turned out a better product than the Sanpoil. Her (?) pots could be used for stone boiling, while a second and superior variety, which could be placed on the fire, was pit roasted rather than sun-dried, as was the first. Seemingly something of the use of tempering was understood although sturgeon glue, obviously not a tempering material, was mixed with the clay; presumably it served as a binder. The pots were apparently not reinforced with a covering of fish skin as were those of the Sanpoil. One gathers that one of the few shapes was closely similar to the flower pot or, as Ray describes it, cooking basket shape (Ray 1932: 128). An excellent discussion of the distribution of this flower pot shape in both steatite and well-fired pottery may be found in Wedel's paper (1954) on what is certainly Shoshone material. He points out that it has a wide distribution. Earlier in the paper he calls attention to a similarity of shape with the wares of the Baumer focus of Illinois. I should be less cautious than he and suggest that there may well be a genetic relationship between Archaic wares of the east and those of the Shoshone. A manuscript in preparation by George L. Coale and myself will add detail and, we hope, depth to the study of this problem. At any rate an examination of the Kutenai, Sanpoil, and Sarci data is most convincing that they are all of the same tradition. These data are readily available and there is no need to repeat them here. To this tradition should be added, I am sure, the Shoshone pottery and perhaps that of some eastern Archaic manifestations. Indications of further relationships, into the Arctic, will be discussed in the paper now in preparation and have been examined by William Mulloy as part of his doctoral dissertation (Mulloy 1953). It appears probable that we are dealing with an ancient Woodland style which was still active in the Northwest during the historic period.

Okanogan and Similkameen Valleys. During 1952 and 1953 Norman Lerman and Warren Caldwell, graduate students at the University of Washington, carried on ethnographic and archaeological survey work in the Okanogan River valley of north central Washington and adjacent British Columbia. The work was financed by an Agnes H. Anderson grant to me. Supplementary funds were furnished by the Department of Anthropology of the University. Lerman, the ethnographer, recorded several informant references to the practice of pottery making and its utilization. None of the informants appear to have had the first-hand experience that Ray's older informant had. Consequently details are lacking and are not as trustworthy. One informant stated that a

people whom they did not know well, called the K'tkšín, who lived in the Similkameen Valley, had clay pots; they did not know how they were made but the clay could be found anywhere in the valley. It was "mixed with something else." Another person stated that pottery was called tlktčín and was made from a pure white mud from the bottom of a lake. This was mixed with ordinary clay and baked by putting it in the hot ashes of a fire. Shaping was "by hand" (probably molded). A third informant, who also called the pottery tlktčín, stated that some 7½ miles south of Oroville, in the Okanogan River, are small mounds under water. Clay taken from these mounds was shaped by hand and dried hard. "When cooking in these pots, the pots were set directly on the fire." Still another informant stated that white clay from the Okanogan River was used to make pots which were shaped by hand. They dried by themselves but had to dry slowly. The vessels were used to hold water and sometimes they "used them as fingerbowls." One gathers from this that the more northern Okanogan used some form of pottery fairly widely, that it was probably molded, and that some of it may have been partly fired and used over a fire in cooking. Further work in the region would almost certainly increase our knowledge on these and other points. No pottery appears among the southern Okanogan (Post and Commons 1938: 64), hence it might well be that local ceramic arts, if they were recently diffused, may have come from northeast.

Archaeological references to Okanogan pottery are not entirely lacking. Caldwell, while surveying the area, was told that a pot had been found by some boys at his site C-O-2 (Caldwell 1953-4: 12, map). It lay about 50 feet east of the old bridge over the Okanogan River, on the north bank in the eastern part of the town of Oroville, Washington. The pot lay under the turf, embedded in the river bank; it was about 6 inches high and 5 to 6 inches in diameter. Its shape and situation jibe well with the ethnographic data available in Ray and recorded by Lerman. Unfortunately the item was found by school boys, given to another boy, and has never been located. We have no data as to whether it was fired or unfired.

Cattle Point. One of the more intriguing archaeological finds which hint at an extensive work in clay was made while excavating at Cattle Point, San Juan Islands, Washington, and was recorded by King (1950: 69-71). A trefoil of clay and stone slabs comprising a group of bowls with definite lips was found associated with floor remnants. Two other bowls, isolated, were found during a later season. One of the 3 bowls was hemispherical, with an overhanging rim, carefully made, and with a uniform base of clay. It is most reminiscent of a Sanpoil pot in the process of manufacture (Ray 1932: 128). The bowls had been fired to a reddish color and appear to have served as fireplaces or hearths. King (1950: 71) does not believe that they could have served as receptacles for stone boiling. They offer evidence of an interesting utilization of clay, unique in the Northwest so far.

Deep Creek Canyon. A peculiar item of baked untempered clay, which may not even be aboriginal, was found in the foothills along the Deep Creek Canyon. Deep Creek flows north into the Straits of Juan de Fuca, in the northwestern part of the Olympic Peninsula, Washington. The piece is an elongate ovoid; it has a brown, weathered surface. Length is 6.2 cm., central thickness 3.3 cm., weight 94 grams. The ends are blunted. The clay was apparently modeled over a squared stick which tapered from about 1 cm. on a side in the middle to 2 to 3 mm. on a side at the ends. This stick has burned out leaving its impression. Although the Indians of the area practiced stone boiling they had a sufficiency of proper stones and this piece could not have been made for such a use. To the present I have found no possible function for the item, aboriginal or otherwise.

Cedar Cave. Five items of sun-dried clay were found in amateur's backdirt in Cedar Cave, on the Columbia River north of Vantage, Washington. One rectangular item is 4 by 2.25 by 0.75 inches and carries a punctate decoration. Another fragmentary piece has a punctate and incised chevron decoration. Three other items, all fragmentary, have been interpreted as possibly phallic (Swanson 1956: 40, Fig. 12).

McNary Reservoir. The 1948 Smithsonian Institution-River Basin Surveys excavations in the McNary Reservoir, upstream from Umatilla, Oregon, turned up one piece of shaped, indurated clay. Specimen 45BN3/B12/301 was a flattened oval pat of clay 11.8 cm. long, 4.8 cm. wide, and 1.0 cm. thick. It is of an un-

baked, hard, untempered, highly calcareous clay, wiped smooth. The material is light gray-cream in color, fine, dense, and slightly checked. A pine tree or fish skeleton design, such as those seen on the sherd in Figure 1 *a*, had been grooved with a blunt tool on either side. Numerous similar flat decorated objects are found in the area, generally in graves, but they are usually of slate. Designs of the same type, sometimes more naturalistic, have been cut into them. They are interpreted as figurines or effigies, probably of ceremonial utility (Osborne 1950).

In the same area, at site 35UM15, Thomas Garth, formerly of the National Park Service, found a small bowl of unfired clay. The object had been buried in, apparently, a moderately dry situation. Garth (personal communication) states: "It is a shallow bowl with an incurving rim, being 109 mm. in diameter and 52 mm. high. A series of oblique incised lines cover the exterior."

Southern Idaho. The famous Nampa image of southern Idaho has been as well described as possible by Holmes (1889, 1910). Shoshone who were cognizant of pottery have certainly moved widely throughout the southern Idaho area. The Nampa image, however, seems to have come from a sufficient depth, 320 feet (and below a lava flow), to thoroughly becloud the issue — even were we able to point to figurine-making potters in the area. The figurine is female, naturalistic, of reddish-brown baked clay, 1½ inches long. It was supposedly ejected by the sand pump while drilling for artesian water was in progress. The piece was carved with a sharp-edged tool. Altogether, the image is not convincing and would probably be rejected now were it found in far more acceptable circumstances than an early Quaternary deposit.

Lower Columbia. We must travel downstream to the lower Columbia, into the area where the low, eroded Cascades are breached by the Columbia River, before we come upon other records of pottery objects. One such item is figured by Strong, Schenck, and Steward (1930: 67, Pl. 11 *j*) in The Dalles-Deschutes report. It is a small sunbaked tablet decorated with short wedge-shaped punch marks. A similar object decorated with crosshatching and chevrons was found in Site 19, Millers Island (Strong, Schenck, and Steward 1930: 99). Other clay objects have come from Wakemap Mound (Strong 1956). Some are in the possession of local collectors and others were found during the National Park Service-University of Washington excavations of 1953-54. A similar piece exists in the Reeder collection on Sauvie Island.

Several objects of unfired, or at best partly fired, clay have been collected by the unfortunately often too active amateurs in the lower Columbia area. The list of items, none of which has been thoroughly analyzed, includes cylindrical and tabular pieces, figurines, a small unfired bowl, clay beads (?), often conical, and varied broken bits, some of which appear to have derived from small clay balls of about marble size. I can say no more about the latter. The conical pieces vary between 1 and 2 cm. in height and something less in diameter. The elongated clay beads that I have handled vary in size from about 1 cm. to about 2 cm. in length; diameters would cluster close to 0.5 cm. The holes are not drilled but appear to have been formed by the burning out of a central twig or straw. Again, none of these pieces has been subjected to close study. A larger cylindrical piece, crudely modeled, lacks a central perforation; it is 4.7 cm. long by 2.2 cm. in diameter. It and a tabular undecorated fragment 5.5 cm. by 4.0 cm. belong to E. E. Annala of Hood River. Annala (1955) owns 3 other items of interest; two are illustrated here (Fig. 1 *d*, *e*). They are tabular pieces; one edge of each is beveled and smoothed; the other edges are broken, sometimes along deeply incised grooves. The designs are nested zigzag lines (Fig. 1 *e*) and nested chevrons stamped with a V-shaped tool (Fig. 1 *d*). The design effect is the same, and was probably intended to be the same on both pieces. The pieces are almost the same size; *e* is 4.65 by 3.8 by 1.2 cm. and *d* is 4.7 by 3.65 by 1.7 cm. Both are of unfired, untempered, fine, red-brown clay, well compacted. That shown in Figure 1 *e* is somewhat harder (hardness of about 2) and darker than *d*; it may have been partly fired or rested near a fire. The items are obviously fragments; they may be remnants of vessels, either rim or reshaped body pieces or of decorated plaques or tablets. They do not belong to any known aspect of either the archaeological or ethnographic culture.

Caldwell (1956) has also described 2 figurines found by collectors in the Wakemap area.

They are triangular, 5 to 6 cm. long from shoulders to feet and 3 to 4 cm. across the shoulders. Both examples lack head and feet. Arms are appliqué; slashes or grooves outline fingers and legs which are closely held together. The figures are of unfired, untempered fine clay. They appear to be sexless. Caldwell concludes: "Currently it seems impossible to indicate a detailed pattern of relationship between Wakemap and either the Northern Periphery or California samples. The geographic contiguity, the presence of other material ties and the uniquely distinctive character of the artifact makes the implication of relationship unequivocal." Further observations on Wakemap area clay working will appear when the present excavations are reported.

Cressman (1942: 91, Fig. 94 *f*) has described sherds from Catlow Cave No. 1, upper levels. These pieces, which I have examined, are superficially very similar to Shoshone pottery from Idaho and Utah. An unusual fired material was also found in Hobo Cave, on the Oregon side of the Columbia in the lower Columbia area. The fragments are best explained as thin layers (up to ¼ inch thick) of clay-mud settling that have been fired. They are probably fortuitous.

The Koethe Specimen. The sherd from near Salmon Creek (Fig. 1 *a, b, c*) is 7.5 by 5.8 cm. Thickness is not uniform; on the straight side it is regularly slightly over 1.0 cm. in thickness from rim to bottom. The other side shows a range from 9 mm. below the rim on a level with the hole to 1.3 cm. immediately above the point where the inner curve flattens into the bottom. Extreme bottom thickness is 1.8

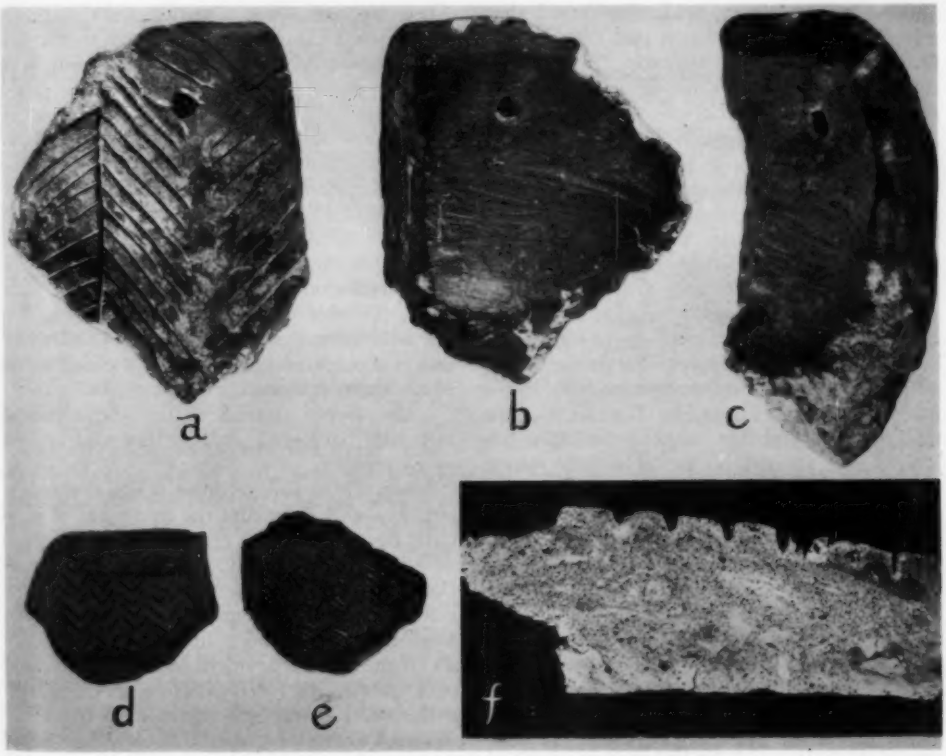

FIG. 1. Pottery from the Northwest. *a-c, f,* sherd in Harold Koethe collection, found near Vancouver, Washington. *a,* exterior; *b,* interior; *c,* edge; *f,* thin section, enlarged about 7 times (straight ungrooved edge is vessel interior). *d, e,* tabular pieces of indurated or partially baked clay in E. E. Annala collection, found at Wakemap Mound.

cm. This thick bottom argues for a heavy mortar-shaped vessel. The sherd weighs 60 grams. A hole 1.7 cm. below the rim was punched from exterior to interior, while the clay was yet soft. Although the perforation appears to be for suspension it shows no wear or evidence of such use. The rim curve indicates a diameter of 10 to 12 cm. The rim itself is carried smoothly to the top on the exterior. The interior aspect curves in and breaks sharply to a secondary interior edge (Fig. 1 *c*). The interior (straight side in thin-section, Fig. 1 *f*) is deeply carbon stained, as can be seen. The thin-section illustration is, essentially, negative, made by using the thin-section as a negative in a photographic enlarger. Consequently the denser areas of the thin-section are lighter and the less opaque materials, such as the quartz fragments, are darker in the illustration.

Both 1 and 2 ceramic engineers who examined the specimen, and to whom I shall refer later, were sure that it had been heavily floated or, more likely, slipped. This probable slip is visible in the thin-section and on the edges in Figure 1 *b* and *c*.

The exterior decoration has been grooved deeply into the slip, in places slightly over 1 mm., with a fairly sharp tool, while the clay was plastic. The vertical cut was made first. The incisions appear to have penetrated through or nearly through the slip. As with the Annala clay tablets from Wakemap Mound (Fig. 1 *d* and *e*) the breaks have often followed the grooves, as can be seen along the right edges of both pieces in the figure. The design on the sherd is a common one, archaeologically, in the middle and lower Columbia. We call it a pine tree or, and probably more correctly, a fish skeleton. It appears on probable fetish pieces and has been mentioned previously herein. The more fragmentary element, at the right, appears to have been made first; following this the section which is now between the two was smoothed, thus erasing some of the more careless, trailing cuts, and then the left element was formed.

The exterior is a deep gray with tan tones, close to Maerz and Paul (1930) Plate 56 1 E in the darker, smokier areas. The interior approximates their Plate 56 1 A. It has been wiped, scraped, and in places shows smoothing, all with a horizontal stroke. All aspects, interior, exterior, and inner paste have a hardness less than 4 and greater than 3. The paste offers intriguing evidence and problems. I was aided in the study of the material by George E. Goodspeed, Professor of Geology, by James I. Mueller, Professor of Ceramic Engineering, and by Hal J. Kelly, metallurgic engineer of the U.S. Bureau of Mines, all at the University of Washington. Goodspeed, to whom I go with most of my geologic and petrographic problems, had the thin-section made for me and examined it as a geologist. Mueller and Kelly examined the piece and thin-section as ceramicists and Kelly was kind enough to dictate his impressions while scrutinizing the thin-section under the microscope. I quote his remarks: "The body is a heterogeneous mixture of clay, feldspar, silica, and quartz, plus other clay minerals which would indicate it is probably of glacial origin from a highly heterogeneous mass. The condition of the edges indicates that it has apparently been fired, at least on the surface. There has been some migration and dissolution of iron oxide throughout the body to the surface; whereas in the interior of the body, iron oxide remains in more or less discreet areas indicating little migration. There appears to be little if any solution of the quartz or feldspar toward the center of the body, as contrasted with indications of slight solution on the edge of the surface of the piece. None of the crystals has been fired sufficiently highly to lose the optical characteristics. There appears to be some radiation of particles throughout the piece, probably due to working, forming. Dr. J. I. Mueller suggested that it is very likely that this is a surface slip in which the decorative effect has been incised."

I am deeply grateful to the above named men who have given of their time and interest to my problem.

Inasmuch as the hardness is equal throughout, it would seem that the firing was of sufficient duration for the entire pot to have been raised to approximately the same temperature. Both Kelly and Mueller agreed that the firing heat must have been greater than that usually attained on an ordinary fire but that it was of about the order that might have been expected of a glowing bed of wood coals. Obviously, therefore, the piece was intentionally fired.

There exists some doubt as to the origin of the quartz crystals which form a fine and effective tempering. The geologist felt that these fragments were so fine, so regular in size and so consistently angular that they might well be

artificial. The ceramicists, on the other hand, suggested that a fine glacial clay which had undergone little or no transportation could well contain such angular particles. This problem, so important from an anthropological viewpoint, must remain unsettled until we have examined local clay deposits. If the tempering is artificially crushed quartz we have a ceramic sophistication in the area that is totally unexpected. It would seem more probable that the Indians found a clay bed that was outfitted with a natural temper. The few large clay inclusions in the groundmass would argue against intentional preparation before forming the piece. None of us was able to detect evidences of coiling. The item is presumably hand molded.

Few suggestions can be made here. The site of origin of the sherd is in Chinook territory. The Chinook (if the site pertains to that group) were slave traders. It is possible that a Shoshonean slave may have suggested or tried her (?) hand at pottery on the Lower Columbia. The piece, however, shows none of the attributes of Shoshone pottery. It seems to be experimental, and luckily so. I tentatively suggest that the specimen may have seen use as a lamp. The interior is darker and shows evidence of greater firing. Most of the alterations of the constituent particles were on the inside edge of the thin-section. This suggestion is made with no ethnographic background. It is of interest that the decorative motives on all of the clay items are remarkably consistent. There is every indication of a well-established complex.

Summary. Certainly there is a more extensive distribution of clay artifacts in the Northwest, especially the Plateau, than previous evidence has suggested. Future workers in the area should be alert for information along these lines on both ethnographic and archaeologic levels. No doubt the use of stone mortars and bowls, and the prevalence of the earth oven and stone-boiling in baskets would have made the acceptance of pottery, at least for cooking, difficult or dubious in the region. If we continue to find evidence of the ceramic art it will presumably be in other categories, such as most of those described. It will probably not be explained on the levels of ethnographic diffusion but rather upon the bases of more deep-seated, old cultural relationships, presumably with representatives of the more ancient aspects of the Woodland pattern.

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EARLY SITES IN THE PISCO VALLEY OF PERU: TAMBO COLORADO

FREDERIC ENGEL

TAMBO Colorado is the name given to a group of buildings standing on the north bank of the Pisco River in southern Peru, 45 km. east of the Panamerican Highway. These buildings are definitely Incaic, but were built on an earlier site, and are no more than a very small portion of a large occupied area extending to the west, north, and east of the buildings.

Both banks of the Pisco River were densely populated during Precolumbian times, and establishments much larger than Tambo Colorado can be observed in the area. They should all be checked for early settlements, and with additional information it would be possible to study contacts between the Sierra cities — of which the best example is Huaitara, 40 km. inland from Tambo Colorado — and the coastal sites, like Paracas, Jahuay, and Hacienda Alta de Luna, near Pisco, where Paracas type pottery can also be found in quantity.

Tambo Colorado has been visited by various archaeologists.* Bandelier photographed and mapped the site in 1893. Uhle worked there for a month in 1901 and mentions various sites in his field notes. William Curtis Farabee also visited the Pisco Valley in 1922 and worked in Paracas; Inez Haase, of the University of California, took notes and photos of the Inca buildings a few years ago, and Harth-Terre (Urteaga 1939) published a plan of them. Kroeber visited the site and published photographs of it (1944: 41, Pls. 18-20).

A detailed plan of the area has not been published. We therefore consider it of interest to publish the sketch map which accompanies this paper (Fig. 2), to give an idea of the importance of the area. Signs of occupation cover an area 2 km. from east to west and extending 1 km. inland toward the east-west arm of the Andes which flanks the northern bank of the Pisco River.

We have not yet been able to establish more than 3 major periods of occupation for the area as a whole: Paracas Cavernas, Monumental Nazca, and late precolonial. We have failed to establish a notable late Nazca occupation or a Tiahuanacoid one. The area seems to have been densely occupied in early and florescent times, abandoned, and intensely reoccupied in late precolonial times. Remains of other periods may be present but unlocated. Possibly, also, plain ware of intermediate periods has gone unidentified. It should be noted that of some

* The author is indebted to John H. Rowe of the University of California for this summary of previous explorations at Tambo Colorado, and for numerous suggestions concerning the preparation of this paper.

3000 surface sherds collected, less than a few dozen could be attributed to late Nazca, and none to a Tiahuanacoid style.

Late architecture, graves, pottery, and implements are mainly related to Late Ica, with local traits and Inca influence. They will be described in another paper. The present paper will be devoted to earlier sites and graves.

Geographically, it is interesting to note that 2 belts of early occupation (Paracas Cavernas and Monumental Nazca) can be observed. The first lies along the steep slopes of Cerro Pantaico and Cerro Tambo, between 20 and 80 m. above the river (Fig. 2, Sites 3, 24, 25, 26, 91, 92). The second is much higher, along the slopes of the east-west arm of the Andes and on the crests of Cerro Pantaico and Cerro Tambo, at an altitude varying between 500 and 700 m. (Fig. 2, Sites 28, 32, 52, 55, 57). Late occupation is scattered all over the area, on the intermediate ridges (Sites 8, 10, 21, 22, 41-43, 45, 48, 71, 81-83, 95, 96), and on Cerros Pantaico and Tambo (Sites 21, 23, 91, 93, 94), and, of course, around the Inca buildings along the Pisco River.

Architectural remains are to be found all over the area. A complete description of major types of buildings would require a much more extensive field survey and the publication of a monograph. The association of sherds and other items already permits the dating of many structures, such as the buildings used as collective graves, which are full of bodies buried with personal belongings, decorated in Inca style. These buildings have mostly been looted by private collectors. Some Paracas Cavernas and Monumental Nazca sherds can also be found in these buildings, but it seems likely that these fell in during the course of construction, or at the time the sites were looted. Terraces surrounding the still partly erect large house on Site 27 also can be dated by the Inca-decorated sherds which we found in the fill. The large group of buildings established on 4 terraces in the slope of Cerro Pantaico just behind Site 27 is protected by a [illegible]g, thick wall. The architecture here is sim[illegible] to that of the wall protecting the Inca ci[illegible] of Pallasco, a few kilometers down the va[illegible]ey. Structures on Sites 21, 22, 28-30, 41-45, 51, 83, 91, 93, and 95 all have Incaic or late Ica-related sherds lying around. All these sites match the well-known ruins of the Tambo, which is now cut in half by the road from Pisco to Castrovirreyna and Huaitara.

FIG. 1. General view of Pisco Valley, looking east. The Tambo Colorado sites lie in the middle distance, left of center.

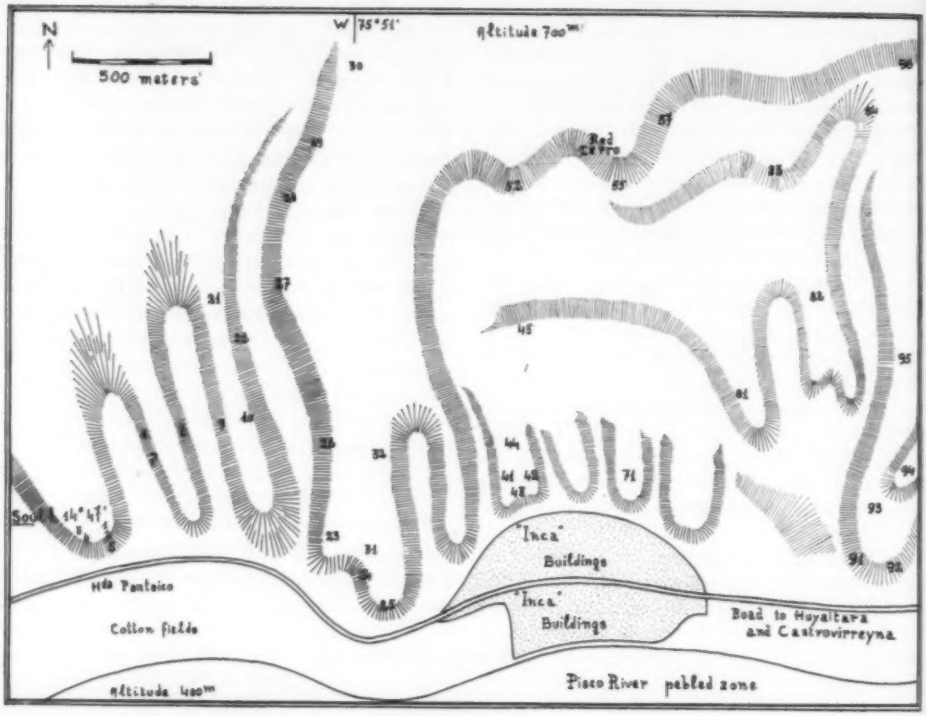

FIG. 2. Sketch map of Tambo Colorado. Separate sites in the area are indicated by number as follows:

1. Collective grave.
2. Cut stone terrace.
3. Stone houses.
4. Stone houses and terraces.
5. Collective grave.
6. Stone terraces.
7. Stone houses.
8. Stone houses.
9. Stone wall and stone-paved alley.
10. Stone houses.
21. Stone terraces.
22. Stone houses.
23. 4 collective graves.
24. 6 collective graves.
25. Stone terraces and semisubterranean houses.
26. Ensemble of large stone houses.
27. Ensemble of large stone houses, other ruined houses, and stone terraces.
30. Shelters and houses.
31. Individual graves, semisubterranean houses, stone terraces, and ruined houses.
32. Semisubterranean houses, stone terraces, ruined dwellings, and food storage units.
41, 42. Ruined buildings.
43, 44. Round excavated holes.
45. Stone houses.
52. Stone terraces and ruined houses.
55. Semisubterranean houses, stone terraces, and individual graves.
57. Stone terraces and ruined houses.
71, 81, 82. Stone houses and stone terraces.
83. Tapia and stone building.
84. Stone terraces and stone walls.
91. 2 collective graves.
92. Semisubterranean houses, stone terraces, and individual graves.
93. Various ruined stone buildings and round individual graves.
94. Stone walls.
96. Stone terraces and stone walls.

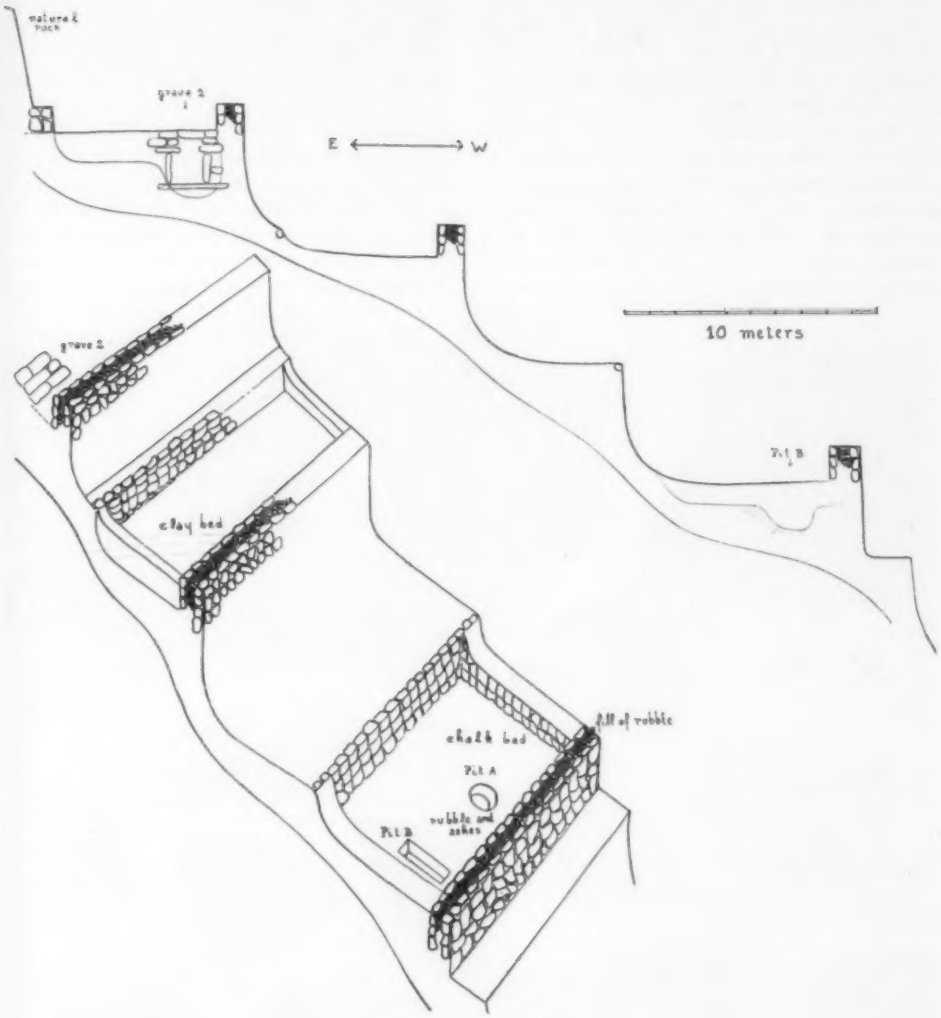

FIG. 3. Terraces of Site 26, Tambo Colorado, in profile and in perspective view.

Sites where earlier sherds can be found are much more difficult to associate with a definite cultural period. They usually have been destroyed, perhaps by tectonic movements, and have generally been reused or modified by late structures. A major effort should be devoted to the clearance of some of these sites; this means, in most cases, that the ground has to be cleared of heavy slabs, boulders, and fallen rocks; no deep digging is necessary, as the rocky bed of the hills is very close to the surface.

For the present, we wish to note a number of associations and publish the results of the excavation of a few graves. Further field work would permit the clearing of architecture definitely corresponding to the Paracas Cavernas period. In that sense alone, the Tambo Colorado area should attract other archaeologists.

Of organized ensembles of terraces and large buildings, only the large complex of Site 26 can yet be associated with an early period (Fig. 3). It is composed of 12 artificial terraces built on the western slope of Cerro Pantaico facing west. The terraces are built of small field stones in layers 50 cm. thick, lying on the mountain rock. In places the rubble is replaced by a bed of white material which looks like chalk. The eastern and western walls, parallel to the slope, are 80 cm. thick and made of 3 rows of stone blocks and field stones, from which the clay cement has mostly disappeared. Smaller lateral walls limit the terraces on each

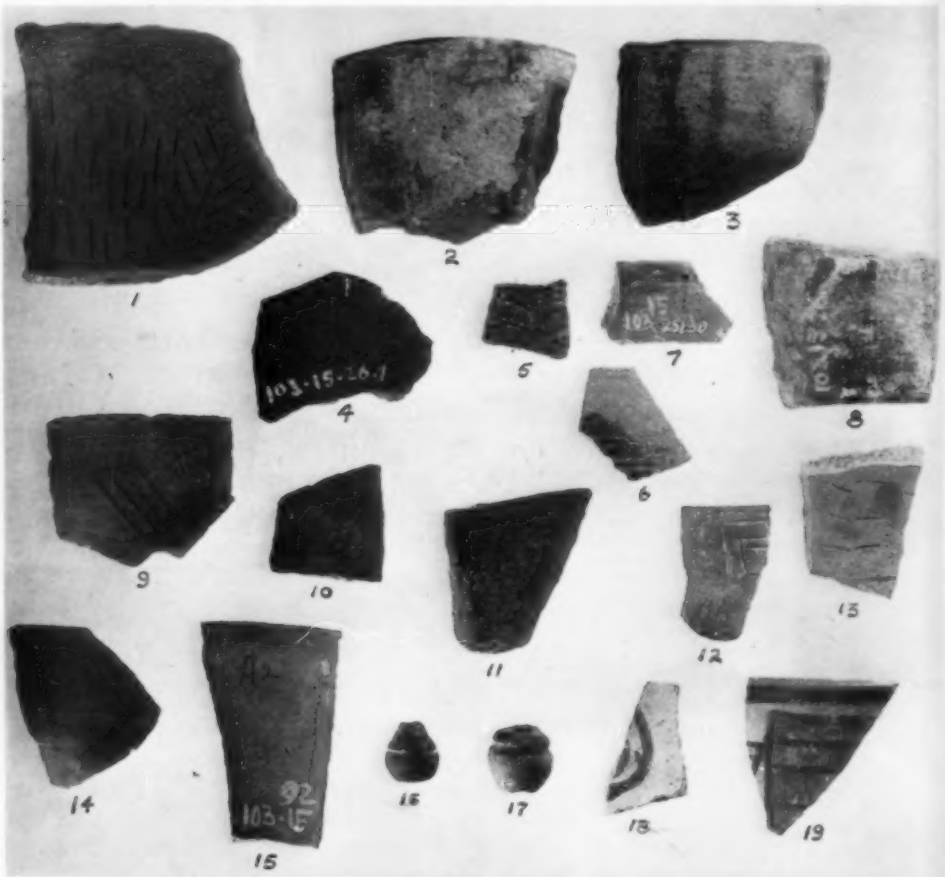

Fig. 4. Sherds and spindle whorls from Tambo Colorado Sites 24, 26, 52, 91, and 92.

end. These are made of 2 rows of stones filled with rubble between. The vertical distance from terrace to terrace runs as high as 3 m. Dimensions of the terraces are usually from 3 by 7 m. to 3 by 9 m. The horizontal distance between terraces is about 10 m. The whole structure constituted a major construction effort. Two test pits (A and B) were sunk in Terrace 2, one in the center and one in the northwest corner. Both yielded ashes, animal bones (some cut and incised), sherds varying from Paracas Cavernas to Phase 7 of Dawson's 9-phase chronology for the Nazca style. Samples of this material are shown in Figure 4, *1-6, 8, 10, 11.* (Lawrence E. Dawson of the University of California has very kindly identified photographs of Nazca sherds from Tambo Colorado and all attributions to the phases of his classification are based on these identifications.)

At an altitude of 700 m., on the highest part of the slope, overlooking the whole area, a low, eroded hill extends to the south. The surface of this hill is red from oxidation of the metalliferous rocks of which it is formed, reminiscent of Cerro Colorado in Paracas. The hill is surrounded by an ensemble of terraces and oval, semisubterranean stone houses (Site 52). The area has been badly disturbed, but in removing the stone blocks which cover the ground one finds Paracas Cavernas sherds. Sinking several

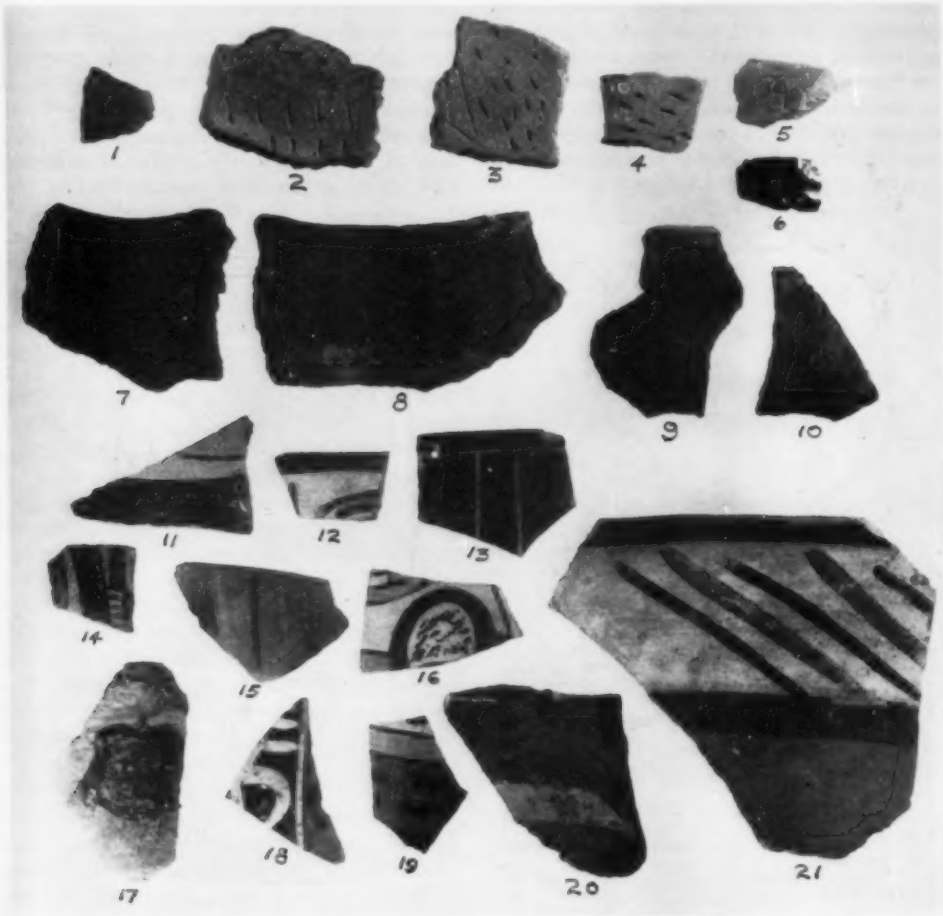

FIG. 5. Sherds and obsidian from Tambo Colorado Site 32.

test pits in this area, we found quite a few Paracas Cavernas sherds in situ, as well as a black clay spindle whorl, incised and filled with red and white pigment (Fig. 4, *16*). Houses here were built between rows of walls 1.5 to 2.0 m. apart, made of flat rocks and forming terraces going down the slope. The inner wall (on the higher side of the slope) is usually higher than the outer one. Both show a rather well-dressed surface of blocks laid flat and cemented with clay. The floor between the walls is covered with a hard clay.

Houses of this type appear all over the Tambo Colorado and Cerro Pantaico area, mainly on Sites 3, 4, 24, 31, 32, 52, 91, and 92. They always contain sherds ranging from Paracas Cavernas to Nazca 4 of Dawson's classification. On Site 32 this type of house is surrounded by agricultural terraces and food storage units built under rocks forming a natural shelter or sheltered with stone slabs. One of the houses of Site 32 was built in a more elaborate fashion. It has lateral dividing walls, extending outward toward the next terrace. All the walls are formed of 5 rows of piled-up blocks. Corners of the house are marked by large, long, pointed triangular slabs of rock. The refuse of the houses on Site 32 includes obsidian flakes, and sherds ranging from Paracas Cavernas to late Nazca, of which samples appear in Figure 5, *1-21*.

Late graves, collective and individual, are easily detectable in the area, as they have been thoroughly plundered. Early graves, on the other hand, are small, well hidden, and difficult to approach, as the ground is covered with large stones. We were able to locate only three of these early graves.

Grave 1 was located 2 m. south of Collective Grave 1, on Site 24. It was cut 1 m. into bedrock, which protects it on the west, and it faces west. In its upper part the grave is hexagonal in shape, 80 cm. broad. At a depth of 60 cm. it forms a square funeral chamber with a few stones cemented with clay on the eastern side (Fig. 6). Two crushed skeletons lay on the floor of the tomb in the southeastern corner, surrounded by the objects described below. The

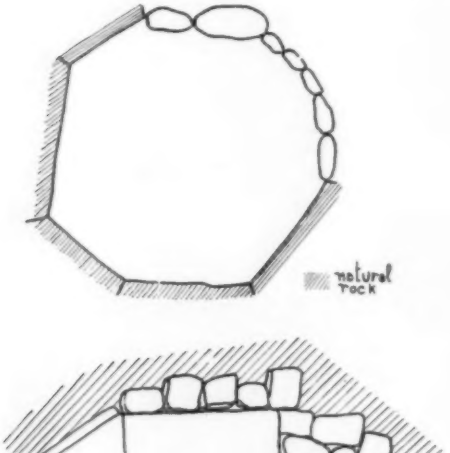

Fig. 6. Grave 1, Site 24, Tambo Colorado, in plan and in perspective view.

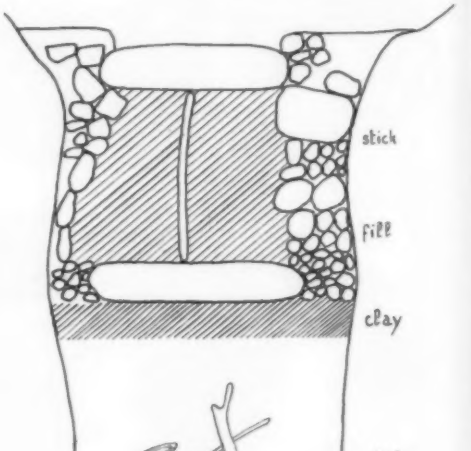

Fig. 7. Diagrammatic cross section of grave at Site 27, Tambo Colorado.

position of the skeletons could not be determined. Only one skull could be found; it was occipitally flattened. A few remains of carbonized cloth, probably of cotton, were attached to the bones. The skeletons were covered with a mixture of clay and small river pebbles.

The artifacts associated with these 2 skeletons include the following:

1. 6 spindle whorls, 5 with incised designs (Fig. 9, *7-11*).

2. 2 obsidian projectile points (Fig. 9, *13, 14*). These are leaf-shaped with straight bases, shaped by percussion flaking and finished by pressure flaking. On one, retouching is limited to the edges, on the other, fine parallel flake scars cover both faces. They are of the broad, flat type found in Paracas sites on the Paracas Peninsula. They measure respectively 5.6 and 5.5 cm. long, 2.7 and 2.6 wide, and 0.9 and 0.7 cm. thick.

3. 3 bowls and 1 plate, Paracas Cavernas style (Fig. 12).

4. Large fragments of 4 additional vessels, Paracas Cavernas style (Fig. 9, *1-4, 12*).

5. Several Paracas Cavernas sherds (Fig. 9, 5, 6).

The paste of all of the complete and fragmentary vessels is hard and fine, with a small quantity of sand temper. All are basically oxidized, though the paste is variable in color and usually has a gray core. Surfaces are well smoothed and most specimens have a medium polish, with polishing marks prominent.

The 8 whole or reconstructable vessels include 4 open bowls with flattened bottoms and diverging, straight, or slightly flaring walls; 2 round-bottomed, convex-sided bowls; and 2 shallow dishes or plates with flattened bottoms and nearly straight walls. The 2 complete diverging-sided bowls measure respectively 18.5 and 18.0 cm. in diameter and 5.5 and 5.5 cm. high. Both are covered inside and out with a red slip applied before firing, and one has incised geometric designs in 2 small panels below the rim on the outside wall. The 2 fragmentary vessels of the same shape have a black slip applied before firing inside and out, with geometric designs in a narrow band around the inside of the rim, painted after firing with resin-based pink and red pigment, and outlined by incision (Fig. 9, *1-3*). One has 2 pink bands around the outside, between which are lozenges of 5 irregular pink dots, painted after firing with the same pigment (Fig. 9, *2*).

The complete convex-sided bowl measures 17 cm. in diameter and 6 cm. in height, and is decorated only by a red band applied before firing around the inside of the rim. The incomplete specimen of the same shape is slipped red inside, black outside, and the outside walls are covered with irregular dots of pigment applied after firing (Fig. 9, *4*).

Of the 2 plates, one is 18 cm. in diameter and stands 5 cm. high; it is decorated with a red slip inside and black slip outside. About 3/5 of the outside wall is devoted to a panel with geometric designs, painted after firing with brown, yellow, and red, outlined by incisions. The remaining 2/5 bears a negative-painted design of red dots on the black background (Fig. 12). The second plate (Fig. 9, *12*) is fragmentary. The inside is slipped red, the outside walls covered with incised geometric designs and incised-outlined bands, of which the upper

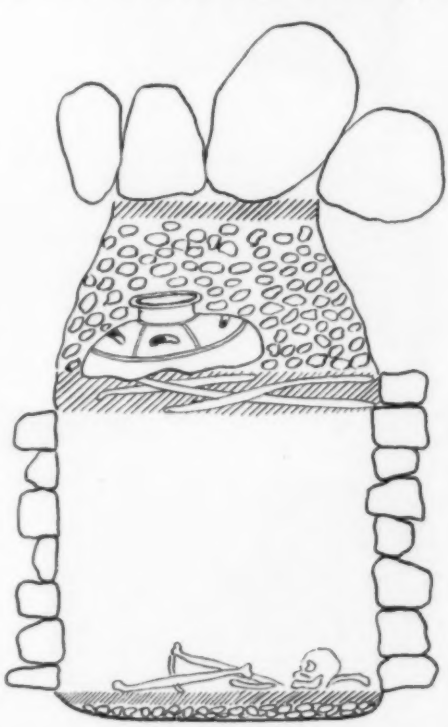

FIG. 8. Diagrammatic cross section of grave at Site 24, Tambo Colorado.

set is filled with red and pink pigment applied after firing, resin based as on the other vessels.

A second individual grave of the same type as Grave 1 was cleared on Site 24, at the foot of the exterior wall of Collective Grave 4. As we found Monumental Nazca sherds (Phases 2 to 4 of Dawson's classification) mixed with the fill, it seems that this grave was not intact. It was probably destroyed when the nearby collective grave was dug. Its general structure is the same as that of Grave 1, and the fill also contained early incised sherds and a piece of cloth embroidered in Paracas Cavernas style. A percussion-flaked scraper of a pale blue igneous rock lay on the floor of the tomb. The skeletons had disappeared and only a few pieces of human bone could be found in the fill.

Grave 4 was situated 5 m. south of Grave 1. It was marked by a circle of large stone blocks. It contained a single skeleton, with a markedly

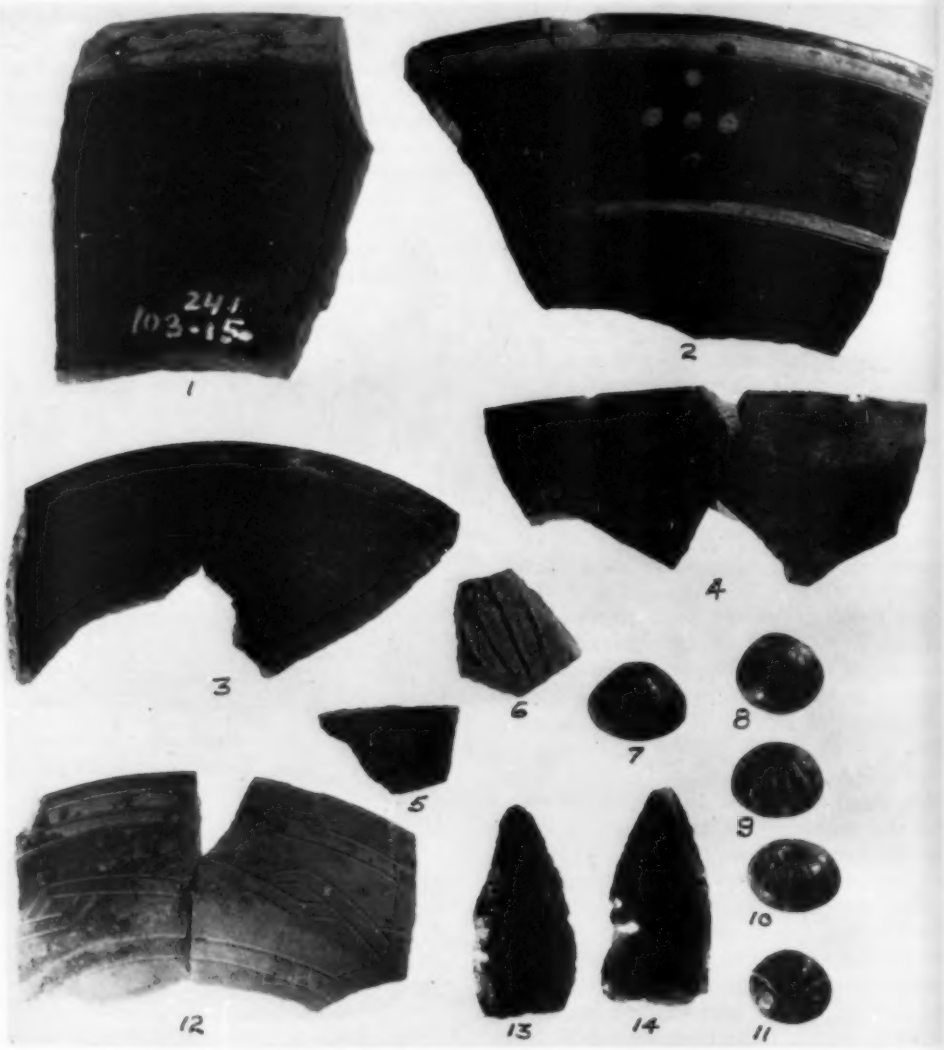

FIG. 9. Sherds, obsidian points, and spindle whorls from Grave 1, Site 24, Tambo Colorado.

deformed skull, seated and flexed. Beside the skeleton we found guinea pig bones, a clay spindle whorl (Fig. 4, *16*), and some beans. Sherds of Nazca Phases 2 to 4 were present in the fill.

An interesting sherd collection was also gathered in the fill of a house located on Site 24, just beside the big collective burials which stand there. Samples appear in Figure 10. The collection includes plates and bowls of the types found in Grave 1 (Fig. 10, *1, 3, 4, 6, 7, 10-16*). One sherd (*5*) differs in that the postfiring red pigment is applied on a reduced-fired paste; another (*10*) has a water-based pigment of the

FIG. 10. Sherds from fill of house, Site 24, Tambo Colorado.

sort which occurs at the "Juan Pablo" site in the upper Ica Valley. Figure 10, 9, *17-19* are punctate and incised unpainted redware sherds of the Paracas style, and *20-24* are Monumental Nazca sherds (Phases 2 to 4 of Dawson's classification).

Sites 91 and 92 yielded sherds of interest ranging from Paracas Cavernas to Nazca 4 (Fig. 4, *12, 13, 14, 15*).

On the western slopes of Cerro Pantaico, between Site 24 and the crest, surface sherds consist of a mixture of Nazca 2 to 7 and of Paracas Cavernas (Fig. 4, 9).

A few interesting sherds gathered from different locations of the area also appear in Figure 11: 5 is painted red on pale pink slip, with geometric designs; 8 and 9 show variant — probably Cavernas — incised line decoration; *7, 10-13* are variants of Paracas Cavernas; and *1, 2, 4-6* are Nazca sherds.

Summary. The principal significance of our survey of the Tambo Colorado area is the demonstration that the Paracas Cavernas ceramic style extends as far east as the middle Pisco Valley. It is also of interest to note that the Tambo Colorado area yielded one sherd

FIG. 11. Sherds from various localities of Tambo Colorado.

painted after firing with water-based pigment, which until now has not been reported outside the upper Ica Valley, and which has not previously been reported from the same site or area as resin-based painted pottery.

Our principle grave lot (Grave 1 of Site 24) includes 8 painted vessels and fragments of several others. Although the above-mentioned sherd indicates that water-based pigment was used at Site 24, all the material from Grave 1 is painted with resin-based pigment. As far as this grave lot is concerned, the latter pigment can be considered isolated from the former.

Two olla sherds from the fill around and in the house excavated on Site 32 have the dark brown, heavily tempered paste and the "comma-shaped" thickened rim characteristic of the plain ware of central coast Chavinoid styles. Unfortunately, they do not occur here in an unmixed Paracas assemblage.

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Lima, Peru
August, 1955
Revised October, 1956

FIG. 12. Bowl of Paracas Cavernas style from Grave 1, Site 24, Tambo Colorado.

CORRECTION

In "Momil: A Formative Sequence from the Sinú Valley, Colombia," by Gerardo Reichel-Dolmatoff, Volume 22, Number 3, the caption of Figure 1 (on page 228) should read "*1-3*, dentate stamped" instead of "*1-3*, rocker stamped."

USES OF AERIAL PHOTOGRAPHS IN ARCHAEOLOGICAL FIELD WORK

WILLIAM C. MILLER

AERIAL photographs have been widely adopted in geology, physical geography, agriculture, soil conservation, and forestry, but it is surprising to find how rarely they have been thoroughly exploited in archaeology. This may be due to the fact that most of the literature dealing with the subject of aerial photographs and their uses has been directed to other fields, with very little appearing in archaeological literature. Possibly the earliest use of aerial photographs in archaeology is discussed in Crawford's *Wessex from the Air* (1928), while Reeves's "Aerial Photography and Archaeology" (1936), was probably the first work directed specifically to the American archaeologist. Both works deal more with locating sites from the air and taking aerial pictures of them than with aspects of mapping from aerial photographs or their use in reconnaissance work.

To emphasize the potentialities of aerial photographs in archaeological field work this brief treatment of the subject has been prepared. It is not presumed to be an exhaustive treatment of the subject, but rather an introduction to some of the possible uses of aerial photos, with references to sources of more detailed information for those who wish to pursue the subject further.

In every phase of archaeological field work, from the initial planning and survey through excavation and completion of the reports, there is need for knowledge and records of the geology and geography of the area of operations. Time and monetary considerations usually forbid preparation of detailed maps in the field, and field notes often do not contain all of the information concerning the physiography of the area which eventually is found desirable. Existing maps may be adequate for many purposes, but even the best do not reveal the ultimate detail and character of the country. Topographic maps indicate elevations, slopes, and gross planimetric detail, but fail to reveal the nature of the terrain, whether it is sandy, rocky, brush covered, forested, or completely barren. Nor do they show accurately the minor features of the country such as small canyons, arroyos, or sandy stretches, any one of which could seriously affect the plans of an archaeological surveying party. This is especially true in the Southwest, much of which is not covered by reliable topographic maps. Of those that exist many are both old and so generalized that they are inaccurate.

Aerial photos reveal the landscape in minute detail, and in 3-dimensional relief when viewed in the proper manner. They also have the advantage over maps prepared in the field in that they can be studied long before the party enters the field of operations. Routes of access to remote areas can be examined and evaluated; decisions concerning the type of transportation needed to reach and to traverse the area can be made; points of rendezvous and even campsites can be chosen before the area has been visited for the first time. While in the area the party can maintain its relationship to objectives and to major features of the landscape by reference to the photos, even in the most rugged country. Although surrounded by cliffs or canyon walls the party's position can be determined in a matter of minutes. Should units split off from the main group to work separate areas, they can maintain accurate knowledge of their relative positions by reference to the photos. When unexpected changes of plan necessitate a change of route, alternatives can be studied in detail over their entire extent by means of the photos. Thus expensive and time-consuming reconnoitering trips can be avoided, the most practical path being selected quickly and easily.

It is possible on suitable photos to locate features within 30 feet or less of their true geographical position, permitting the recording of archaeological sites and key points along obscure routes with an accuracy impossible on most field or topographic maps. Site identification numbers and other identifications noted on the *back* of the prints beside pin-holes marking the exact location of the points of interest make a permanent record which does not deface the pictures. Planimetric maps can be prepared, when desired, from photos after the party has returned to the laboratory. Furthermore, duplicate copies of the photographs, with important

data transcribed, can be included in reports in place of planimetric maps.

Details of ruins, undetectable from the ground, often can be seen from the air. Features such as canals, extensive walls covered by sand or vegetation (Crawford 1928; Kruse 1942; Reeves 1936), or patterns outlined with rocks by aborigines have been discovered from the air after they have gone completely unnoticed from the ground (Smith 1943, Pls. 3, 50).*

The use of aerial photographs as qualitative maps of unparalleled detail is relatively obvious and straightforward, requiring little comment. Before they can be used as quantitatively correct maps, however, they must be checked for the presence of certain errors and when present, these errors must be corrected. But for the majority of field application in which aerial photos will be useful to the archaeologist, these corrections need not be actually applied, but must merely be understood and kept in mind in order that the most intelligent use be made of the photos in everyday work.

Aerial photographs are usually taken at an altitude between 10,000 and 20,000 feet above sea level. Factors determining the altitude at which the camera is flown are the elevation of the land surface, the focal length of the camera lens, and the scale desired for the resulting photographs. The relationship of these several factors is expressed in the following ratio:

$$\frac{\text{Size of picture}}{\text{Size of ground area}} = \frac{\text{Focal length}}{\text{Height of plane}}$$

Thus a camera equipped with a lens of 8-inch focal length would have to be flown at an altitude of 12,000 feet above *ground level* to produce a picture in which 1 inch = 1500 feet. It is common practice to express the scale as a fraction in which the picture size is unity, thus:

$$\frac{\text{Size of picture}}{\text{Size of ground area}} = \frac{1}{18{,}000}$$

or as a ratio: 1:18,000. Consequently any dimension measured on the photograph is 1/18,000 of the corresponding distance measured on the ground. Photos with a wide range of scales are available.

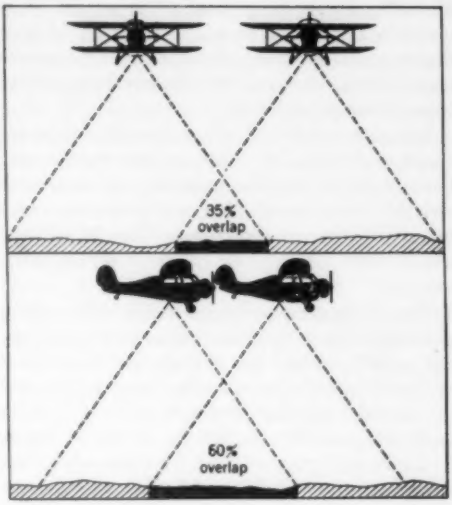

FIG. 1. Diagrams to represent strip flying for aerial photographic purposes, showing overlap and side lap. (Reproduced by courtesy of A. J. Eardley and Harper and Brothers Publishers, New York.)

Pilots usually attempt to maintain a fixed average elevation above the terrain throughout a photo-mapping project. Local changes in elevation of the land surface cause changes in the scale from print to print, and in different sections of a single print. Thus the scale at the top of a plateau may be 1:18,000, but at the bottom of a 1000-foot canyon running through the plateau it will be 1:19,500, a significant difference and one which must be taken into account in accurate work.

Most photographic flights are made in a north-south direction, although special requirements often alter this practice. For example, if a range of mountains exists in the area, the flight will generally be made parallel to the range. This permits each successive strip of photographs to be flown at a fairly constant altitude, but differing from the preceding and following strips by an amount equal to the change in elevation of the ground surface below, thereby maintaining a fairly constant scale on all photos. If the flights were made "across the grain" of the country, the plane would have to dive steeply to follow the downward slope of the range, level off across the floor of the valley, and climb over the opposite range, all the while attempting to maintain a constant

* EDITOR'S NOTE: See also R. S. Solecki, "Practical Aerial Photography for Archaeologists," AMERICAN ANTIQUITY, Vol. 22, No. 4, pp. 337-51 (April, 1957).

elevation above the ground. This would prove virtually impossible in actual practice. If level flights were maintained across the mountains and valleys, the scale of the resulting photos would change violently.

Successive strips of photos are flown in opposite directions in order to save flying time. Each negative in the sequence is numbered serially. As a result alternate strips are numbered in opposite directions. This is a detail which must be watched carefully when ordering prints by number.

The cameras are operated either manually or automatically to produce exposures which overlap by 60%. The lines of flight are maintained as nearly parallel as possible, and are spaced to provide side-lap between adjacent strips amounting to 30% to 35%, as shown in Figure 1. In rugged country and in areas where accurate maps are lacking it is difficult to maintain straight and parallel flight lines. When serious errors have been made on a flight, it is reflown so that all photos offered to the public are adequate for the majority of purposes. Photos resulting from corrective reflights often bear numbers which differ considerably from those of the rest of the area.

A source of potential trouble arises from the occasional tilting of the plane and camera due to rough spots in the air, often present even on the best days. This causes the axis of the camera to depart from the true perpendicular, and the center of the photograph no longer agrees with the plumb-point. Distortion of the scale of distances in various sections of the photograph results. For a method of detecting tilt see Smith (1943: 48). It is rare, however, that a photo is released for use if it has a tilt greater than 3°, and in the majority of photos the tilt is less than 1°. Errors of this magnitude cause no trouble in most applications.

There are several types of aerial photos available whose characteristics depend upon the type of camera employed, the manner in which it was used, and the final treatment given the photographic prints.

1. *Plain Verticals.* Plain vertical photos are made with a single-lens camera aimed straight downward. Prints from such a photo are usually 7 by 9 or 9 by 9 inches in size, with scales ranging from 1:2000 to 1:40,000. Such photos taken with a lens of long focal length from a considerable altitude are the most accurate type of all, suffering only slightly from what is known as "relief error," to be described below.

2. *Composite Verticals.* Composite verticals are made with a camera equipped with several lenses working simultaneously. In the case of the 4-lens composite, each lens takes a picture 5 by 5 inches square, and the axes of the 4 lenses are so aligned that the resulting 4 negatives can be joined along adjacent sides to produce a single 10 by 10 inch print with barely visible lines joining the 4 sections. There is no overlap or gap between these sections and they combine to form a single uninterrupted picture. Since the 4 lenses are aimed outward from the center of the area being photographed, they cover a considerable angular field, and relief error is often greater than in the plain vertical photo. However, this error is not too serious since every feature of the terrain can be found near the center of at least one photo of a series, where the error is small. Furthermore, much of the error can be corrected if accurate maps are constructed from the photos.

Some composite verticals are made with a camera equipped with 5 lenses. The central lens points straight downward and the other 4 point outward in such a manner that the inner edges of the 4 negatives register with the outer edges of the central picture. But these 4 outer fields do not touch along their adjacent edges as in the case of the 4-lens composite. Triangular areas are left which are not covered. The whole array of such negatives resembles a Maltese cross. The triangular gaps are filled in by coupling another identical camera in tandem with the first, which works simultaneously. But it is rotated 45° about its vertical axis in order that the 4 trapezoidal negatives which it produces cover the gaps left by the first camera. As the central compartment of the second camera would only duplicate the picture taken by the first, it is not used. Hence the name, "9-lens" composite.

The composite prints made by this process are about 36 inches across and encompass a large area of the earth's surface. The outer areas shown on such a print have been photographed from a rather large angle from the vertical, with the result that the terrain is seen in an oblique manner, not from straight overhead. As a result the outer areas of the print resemble oblique photos.

3. *Obliques.* Oblique photos are divided into 2 classes, high obliques, which include the horizon as a reference line, and low obliques, which do not. Details of topography are more easily interpreted when viewing an oblique than when viewing a single vertical photo of the same area, but scaling distances on obliques is exceedingly complicated and tedious. Also, in rough terrain, such as is often encountered in the Southwest, too much area is hidden behind hills and cliffs. Therefore, obliques are of limited value in most archaeological work, being limited to close-up shots taken on special flights made for the specific purpose.

4. *Mosaics.* Aerial mosaics are of 2 types, uncontrolled and controlled. The former far outnumber the latter. Uncontrolled mosaics result when the best sections of plain or composite vertical prints are selected, matched for density, cut and fitted together with all possible care to produce a single large photograph. Several hundred pieces of individual prints are often incorporated into a single mosaic. By means of great skill, accurate workmanship, and suitable retouching of the completed photograph, mosaics are produced on which it is impossible to detect the joints between individual sections.

Controlled mosaics are produced in much the same way, but with the important difference that instead of contact prints from the original negatives, special prints are made by projection, suitably corrected for tilt and scale errors, and the entire assembly of prints is put together by careful registration with accurately determined ground-control points. It is only for the most exacting work that controlled mosaics are required.

Mosaics are excellent for accumulating the results of several seasons of archaeological work, or for synchronizing the efforts of several field parties working simultaneously. While such prints are usually 16 by 20 inches in size, and represent 15′ of arc quadrangles, enlargements can be obtained to 40 by 40 inches for mounting on office or laboratory walls. With such enlargements site locations can be indicated by colored pins or other easily visible means. Site locations can be transferred with great accuracy to the mosaic from the smaller prints used in the field.

Index Cards and Sheets. To assist in selecting and ordering aerial photos, most facilities make copies of large layouts of prints for all regions which they have photographed. These layouts are an array of contact prints arranged to provide a reasonably accurate picture of the area. No attempt is made to create an accurate mosaic. Each print included in the layout shows its serial number. Such layouts permit one to study the major features of the area and to select the exact prints required to give any desired coverage.

Index Cards are 5 by 7 inches in size and Index Sheets are usually 16 by 20 inches or larger. The latter are often only enlargements of the 5 by 7 negatives and provide little information that cannot be obtained from the contact prints by the use of a magnifier. The cost of these helpful items is such that one can easily afford to make a collection of those covering areas of particular interest. Not only can considerable information be derived about an area directly from Index Cards or Sheets, but the time saved by their use in selecting and ordering prints easily justifies their cost. Most facilities offering prints also have maps available showing the portion of each state covered by their aerial surveys, the year in which each section was flown, and the scale of the original negatives. In view of the fact that many parts of the country have not yet been completely covered by aerial surveys, it is well to obtain these maps in order to determine quickly the availability of photo coverage.

Enlargements. It was mentioned earlier that mosaic prints can be obtained as enlargements. This is true also of all other types of aerial photos. Enlargements in a variety of sizes can be obtained from most vendors who will send literature upon request covering the subject. Aerial photographs can be obtained on 2 weights of paper, single and double, and with 2 types of surface, matte and glossy. The matte surface takes pencil and ink markings reasonable well, but in the field is easily soiled. The glossy surface will not take pencil, but with suitable preparation will accept ink fairly well. Glossy double-weight prints are best for most field uses in archaeology.

All photographic paper expands and shrinks during processing, and does so by different amounts along its 2 dimensions. If prints with great dimensional stability are required, most vendors will provide, at additional cost, prints on special stable waterproof stock.

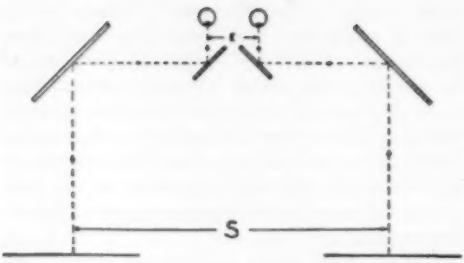

FIG. 2. Diagrammatic representation of the mirror type stereoscope. E is the separation between the eyes, S is the separation between print centers. (Reproduced by courtesy of H. T. U. Smith and D. Appleton-Century-Crofts Company, Inc., New York.)

VIEWING AERIAL PHOTOGRAPHS

Vertical aerial photos present an unaccustomed view of the surface of the earth which, to the inexperienced, may at times be somewhat baffling. The wealth of detail presented is at once obvious, but its interpretation may be less so.

The first requirement for satisfactory viewing and interpretation is proper illumination. This includes not only adequate illumination, but light from the correct direction. Cursory examination of a print will usually reveal the direction in which shadows are cast by objects in the scene. Turn the photo so that the viewing illumination falls across the print in the same direction as the sunlight fell across the landscape at the time of the exposure. With this orientation the topography of the terrain will assume its correct relationship as regards highlands and lowlands. Shadows cast by hills, cliffs, and trees will give the scene a semblance of relief, or third dimension. The entire problem of interpretation of the topography and ground cover depends upon the formation in the mind of a correct model of the scene, and this can be done, at least in the early stages, only when the viewing conditions are correct. Improper direction of illumination will often cause the highlands and lowlands shown on a print to reverse themselves. After sufficient experience, it is not so vital that the relationship always be maintained, for the mind becomes adept at properly interpreting such scenes.

A hand magnifier, of a suitable size to permit viewing through it with both eyes, affords some individuals an impression of a third dimension when applied to a single aerial photo. Aside from such possible advantage, a viewing lens of 2, 3, or even 4 diameters magnification will reveal a vasts amount of detail and information missed by ordinary inspection.

Stereo-pairs. Reference has already been made to the fact that some aerial photos can be viewed in such a manner that the scene is brought into strong 3-dimensional relief. It is common knowledge that 2 photographs of a single scene, taken from slightly different positions, when suitably viewed, give an impression of depth or relief to the scene (Fig. 4). Consecutive prints of a series of aerial photos are ideally suited to this manner of viewing. Any 2 such prints are commonly called a stereo-pair.

The principles of stereoscopic vision constitute a specialized field, and many texts cover the subject adequately. Brief but excellent discussions can be found in Eardley (1942: 27) and Smith (1943, Ch. 3). All other things being equal, the greater the separation between the points from which 2 pictures constituting a stereo-pair are taken, the greater the apparent depth visible in the scene. A stereo-pair, to produce a normal amount of apparent depth, would have to be taken from positions no farther apart than the distance between the human eyes. To take aerial photos at such short intervals is not only impractical but undesirable, for at the altitude at which most flights are made, the human eyes can distinguish no depth in the scene below. To make depth detectable at an elevation of 15,000 feet, the eyes would have to be about 300 inches apart. Even this separation is too close to be

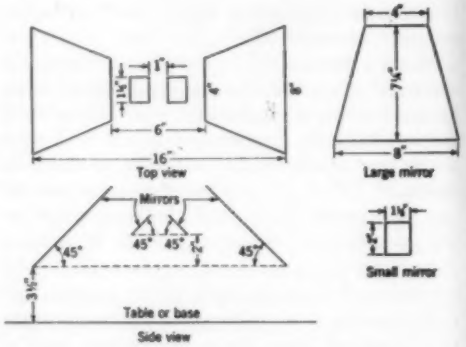

FIG. 3. Detail of size and position of mirrors for a stereoscope suitable for examining aerial contact prints. (Reproduced by courtesy of A. J. Eardley and Harper and Brothers Publishers, New York.)

practical when taking aerial photos, and successive exposures are taken at intervals of a mile or more. As a result the depth of the scene presented to the viewer of a stereo-pair using suitable instrumentation is greatly exaggerated. Hills appear to be far higher, canyons much deeper, and slopes much steeper than they actually are.

Suitable conditions for viewing stereo-pairs are easily provided. Some people, with no optical aid whatever, can pick up a pair of small prints and observe the scene in 3 dimensions. But because of long habit the eyes of the majority of people tend to focus at the same distance on which they converge, making it impossible for them to focus on one print with one eye and an adjacent print with the other, the fundamental requirement for stereoscopic vision. Practice is required to develop sufficient muscular control to permit viewing simultaneously at close range 2 pictures whose centers are separated by a finite distance. But even when skill has been developed, only small pictures or small portions of overlapping large ones can be viewed satisfactorily. In order to view the entire area common to 2 10 by 10 inch aerial photos it is necessary to effectively increase the distance between the eyes to 10 inches or more.

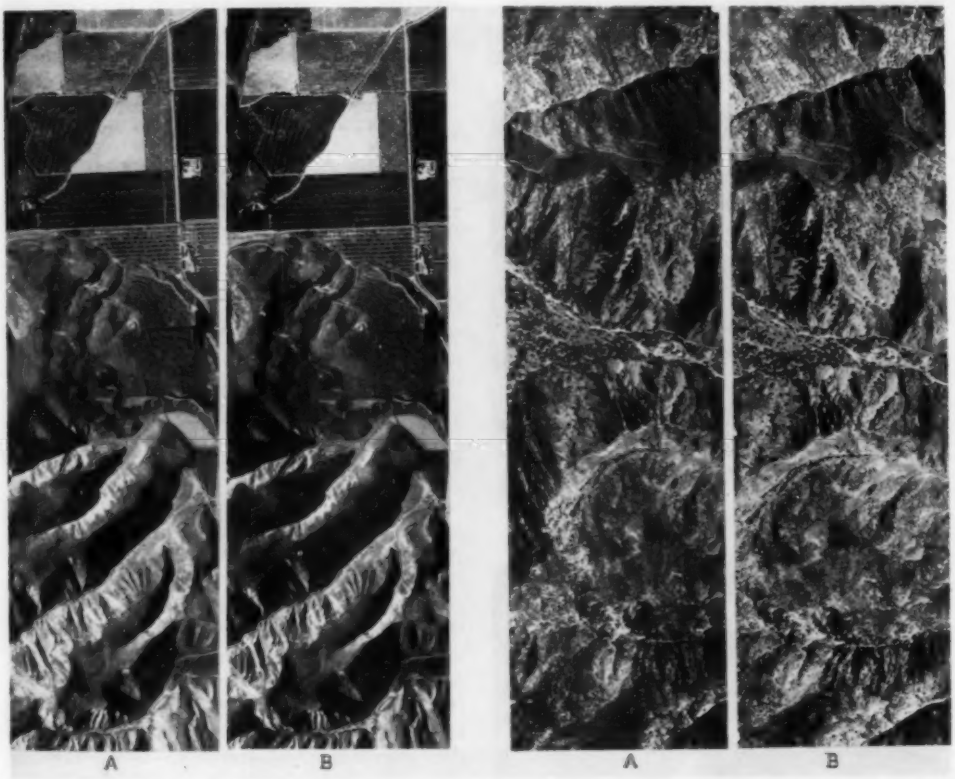

FIG. 4. Sections of 2 different stereo-pairs cut from full-size prints and mounted in such a manner that they can be viewed stereoscopically without the aid of a viewer. Hold a sheet of cardboard between the 2 matching prints so that the left eye can see only the left-hand print and the right eye only the right-hand print. With the page at arm's length, concentrate the gaze on some prominent landmark, such as the light-colored field at the top of the left-hand pair. Slowly the eyes will fuse and focus on the scene, causing it to appear in 3-dimensional relief, particularly the hilly area at the bottom. Areas lacking in prominent landmarks, such as the right-hand scene, are more difficult to fuse. Practice will make it possible to observe scenes without the aid of the separating card. (Photographs from Pacific Air Industries, Long Beach, California).

This can best be done by means of mirrors, as shown in Figures 2 and 3. Excellent stereoscopes can be purchased (see list at the end of this paper), but entirely adequate devices can be built in the simplest workshops.

Two types of stereoscopic viewer will be of interest to archaeologists; for laboratory use a large one which permits examination of the entire overlap area provided by 10 by 10 inch stereo-pairs (Fig. 5), and for use in the field a small pocket model (Fig. 6). While this latter device will permit examination of a relatively narrow strip at any one time, it is entirely adequate for field purposes, and the magnification provided by such an instrument is welcome in accurately locating sites.

When preparing to examine stereo-pairs under a viewer, one must first determine the orientation of the prints and the direction in which the strips were flown. Commercial aerial photographic companies and government departments number their prints somewhere along the northern edge. Since this custom is not without exceptions, it is sometimes necessary to determine the orientation from the direction in which shadows fall across the landscape. Most aerial photos are taken during morning hours with the result that the shadows fall from the southeast to northwest. In cases of doubt, lay out the prints in their respective strips by matching details along their margins. Reference to a good topographic, planimetric, or road map of the area should be sufficient to establish the general direction in which the strips were flown.

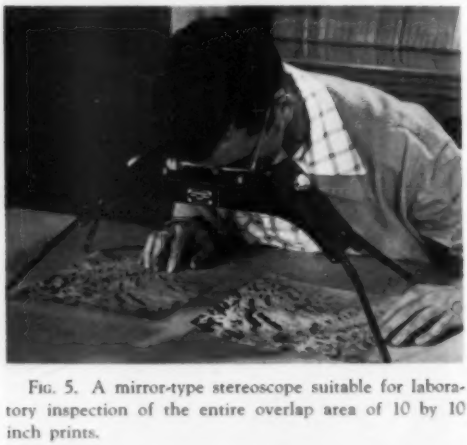

FIG. 5. A mirror-type stereoscope suitable for laboratory inspection of the entire overlap area of 10 by 10 inch prints.

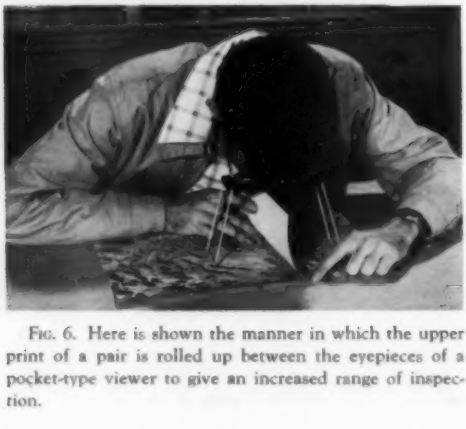

FIG. 6. Here is shown the manner in which the upper print of a pair is rolled up between the eyepieces of a pocket-type viewer to give an increased range of inspection.

When viewing photos flown in the north-south direction, one must have the north edge of each print to the left, and the northernmost print of the pair must be under the left eyepiece. Thus the viewer is, in effect, facing east when examining such prints. Working with prints from east-west flights requires that one have the northern edge of each print at the top and the most westerly of the prints to the left.

To eliminate eyestrain during purely qualitative examination, the prints should be aligned under the viewer with some care (Fig. 5). Until practice has made one adept, it helps to select some conspicuous feature visible on both prints. Place the index finger of each hand on this feature on the 2 prints. While looking through the viewer, slide the prints about until the 2 fingertips are seen superimposed. Then concentrate on features of the landscape and make final adjustments by sliding and rotating the prints until registry over the entire area is satisfactory and the eyes feel at ease. Close the eyes or look away for a moment, then look through the viewer again. If the 2 images do not fuse instantly, further adjustment is required. This can be accomplished by alternately blinking the eyes and noting shifts of the details in the scene. Additional adjustment will complete the alignment. Quantitative work requires more accurate methods, which will be described later.

The use of a small viewer does not permit examination of the entire area of the prints at one time; the 2 prints must be overlapped. This restricts the area which can be inspected, but by rolling up the edge of the top print between the lenses of the viewer, as shown in

Figure 6, it is possible to increase the visible area. When all has been viewed that can be reached in this manner, place the lower print on top and continue the inspection in a similar way until the other edge of the area has been reached. By this means the entire overlap area of 10 by 10 inch prints can be examined.

Small viewers provide higher magnification than large ones, and this is often advantageous in the field. For this reason, and because of the greater portability of a small viewer, it is well to become adept in its use. In the field, however, the magnifying eyepieces of the small viewer can cause embarrassment. When working in bright sunshine, if one raises his head to compare the photos with details of the actual terrain, sunlight shining through the eyepieces can set fire to the prints!

INHERENT ERRORS IN AERIAL PHOTOGRAPHS

For all their wealth of detail and pictorial realism, aerial photos can be accepted as maps only in a qualitative sense. Before they can be used quantitatively in highly refined mapping they must be checked for the presence of certain errors and these errors eliminated if present. Fortunately for most archaeological field work the errors cause little trouble if they are thoroughly understood and taken into account. It is only in the preparation of accurate planimetric or contour maps that corrective steps must be taken. The sources of error are briefly discussed in order that they may be recognized and taken into account. Methods for their correction are described in several excellent texts to which reference will be made.

Relief Error. Due to the appreciable angular field covered by aerial cameras the scene recorded is shown in conical projection with the lens at the apex of the cone. Therefore a tall object, such as a monument, anywhere in the field other than near the center of the print will be seen slightly from one side, not from directly above. The top of the monument will appear to be displaced *outward* from its base. Another tall object elsewhere in the field will also appear to lean outward, but in another direction. Both objects will be found to lean along radii whose center is at or very near the center of the print. Thus, all elevated features are displaced *radially outward* from their true positions. Objects such as canyon bottoms which lie below the datum plane of the photo, will appear displaced *radially toward* the center of the scene from their true positions. This is known as "relief error." Figure 7 shows the geometry of the situation, and Figure 8 diagrams its correction.

Because of relief error a line joining 2 objects of different elevation located in the outer portion of a photo, will not have a true azimuth bearing unless the line joining them is nearly radial to the center of the print. Due to the nature of relief error, it increases toward the edges of each print and vanishes at the center. Hence, by working only in the central area of each print it is possible to avoid the major effects of relief error without taking actual steps to correct it. Aerial photos are flown in such a manner that every point of the terrain can be found reasonably close to the center of at least one print of a series. When it is necessary to correct relief error for accurate determinations of the exact location of an object suffering from relief error, or to establish an accurate azimuth bearing, it is easily accomplished. The method is excellently discussed by Eardley (1942: 55), and is referred to as the "radial line" method of correction.

A numerical example of relief error will establish an appreciation for its effect on the

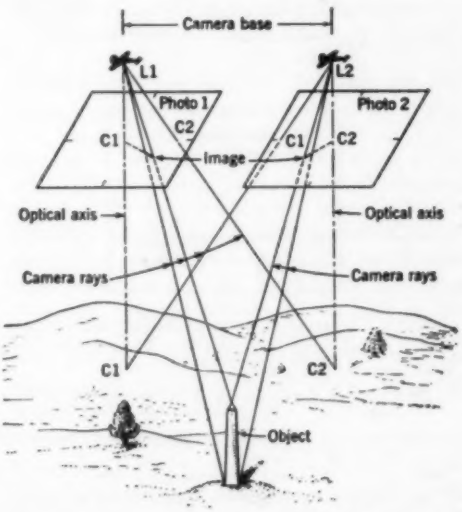

FIG. 7. Diagram illustrating the nature of the image of a monument on a stereo-pair of photographs, and the radial nature of "relief error." (Reproduced from the War Department's *Basic Field Manual* FM 21-26, Fig. 72.)

position of objects. On the print of an area photographed from an altitude of 16,000 feet above the terrain with a lens of 8-inch focus (scale 1:24,000), an object which has an elevation of 500 feet above the datum plane, located 4 inches from the center of the picture will be displaced ⅛ inch outward from its true position.

Tilt Error. When the axis of the camera is maintained in a truly vertical position, the plane of the film is parallel to the datum plane of the earth's surface. In this position the camera will produce an accurately rectilinear picture of what lies below. If the earth's surface is flat and level, the scale of the photograph will be uniform and accurate over its entire area and all bearings which are free from relief error will be rendered true. However, if the camera is tilted from the vertical (Fig. 9), the datum plane and the film are no longer parallel, with the result that neither distances nor bearings are accurately rendered. For an analysis of the effects of tilt the reader is referred to Smith (1943: 43-51), and for a method of detecting the presence of tilt in aerial photos, see Stevenson (1941).

Errors resulting from tilt are small up to a tilt angle of 3°, and since most photos are held to less than this, it is only in the most accurate types of work, rarely encountered in archaeology, that tilt error need be taken into account.

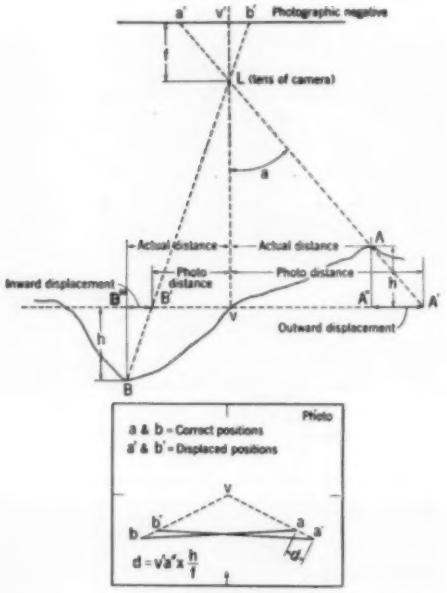

FIG. 8. Diagram illustrating displacements due to relief. (Reproduced from the War Department's *Basic Field Manual* FM 21-26, Fig. 58.)

D = Outward displacement A″A′ or inward displacement B″B′.
d = Equivalent displacement aa′, or bb′ on print, measured in inches.
H = Height of camera above terrain in feet.
h = Height of feature above datum plane in feet.
r = Distance of feature from center of print in inches.
f = Focal length of camera lens in inches.

$$D = \frac{r\,h}{f} \qquad d = \frac{D\,f}{H} = \frac{r\,h}{H}$$

PLANIMETRIC MAPS

Archaeologists frequently find it impossible to obtain *detailed* maps of the area containing particular sites. This deficiency can be overcome by constructing the necessary maps directly from aerial photos. Their accuracy depends only upon the time and skill expended in their preparation. Since there is need for maps of various degrees of accuracy, depending upon the application, several methods, each of increasing precision, will be mentioned briefly, with references indicating sources of more detailed information.

Uncorrected Maps from Single Photos. Relatively crude planimetric maps of small areas can be prepared by the simple expedient of merely tracing detail from a print. The photo should be selected in such a manner that the area of maximum interest lies near the center. No effort is made to correct for relief error. When a reduced or augmented scale is desired, a camera lucida, an opaque projector, or a pantograph is employed. If none of these aids is available, a rectangular grid of fine lines ruled either on the print or on a sheet of transparent plastic sheeting taped to the print facilitates the transfer of detail to a larger or smaller grid on the sheet on which the map is to be constructed. For other suggestions, see Abrams (1944: 97), and Smith (1943: 148).

Uncorrected Maps from Groups of Photos: Method 1. The tracing of detail from a single photo can be extended to several photos, the difference being that detail from any one print is traced only halfway across the area of overlap. Two or 3 conspicuous features distributed over the area of overlap are marked for special

attention. When the tracing material on which the map is drawn is transferred to the next print, these points are registered as accurately as possible with their images on the second print. If points of nearly equal elevation are selected, fair agreement should be obtained. When a difference in their elevation exists, judicious compromise is made, and tracing continued from print to print. Adjacent strips of prints can be employed by a similar registration of points in the side-lap area.

Uncorrected Maps from Groups of Photos: Method 2. Increased accuracy is achieved if each successive print is aligned by means of its "flight lines." Flight lines are established for each print by first locating the accurate positions of their centers. The center of any print can be located by means of marks impressed on the film at the time the negative was exposed and carried over onto the prints. The nature of these marks depends upon the type of equipment used; some prints are marked in the center, some at the corners, while others have marks along their edges. By joining opposite pairs of corner or edge marks the exact center of the print is defined. Careful comparison of the terrain surrounding the center of a print with the same geographic area shown on each adjacent print makes it possible to accurately locate and mark the center on those neighboring prints. This is referred to as "transferring centers." The use of a stereoscopic viewer aids in this operation. At the completion of this step each print except the first and last of a series will have 3 points marked, its own center and the transferred centers of the 2 neighboring prints. Lines joining the center of a print with the transferred centers form what are known as flight lines. These indicate the direction of flight of the plane between successive exposures. If the 2 flight lines of each print are not colinear, it indicates that the plane departed from a perfectly straight course between exposures, but this will cause no difficulty with the work in hand.

The first print is suitably positioned under the tracing sheet. Its center is marked, as is the transferred center of the second print. The flight line is drawn in lightly. If the tracing material is sufficiently transparent, a stereoscopic viewer can be used during the sketching operation by placing the second print under the tracing sheet in such a position that the

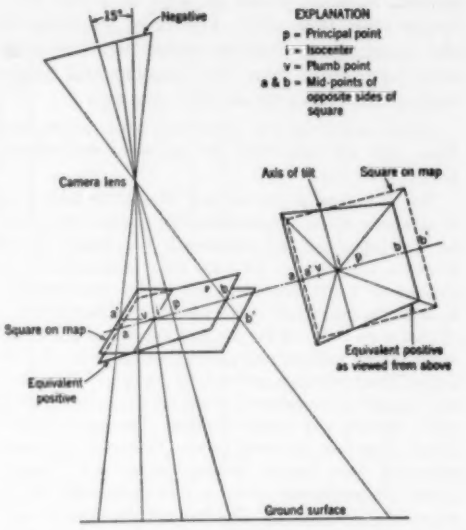

FIG. 9. Diagram illustrating displacements due to tilt. For the sake of illustration the tilt is greatly exaggerated in this drawing. (Reproduced by courtesy of A. J. Eardley and Harper and Brothers Publishers, New York.)

area can be seen in 3-dimensional relief. Care must be exercised, however, that details are traced only from the first print and that the second is used only to increase visibility.

When all desired detail has been sketched from the first print, it is removed and the second slipped into position. Its flight line and center point are registered with those traced from the first print. The third print can again be used to give added visibility of detail if desired. The transferred center of the third print, as found on the second print, along with the flight line, is carefully traced. By this means of registration of centers and flight lines of each print with those traced from each preceding print, the array of photos can be kept in fair alignment while detail is sketched from each print in turn. Compromises must be made for those points subject to relief error. For additional details see Smith (1943: 153-9).

Corrected Maps from Groups of Photos: Method 1. Picture-point Control. A higher degree of accuracy can be achieved if the photos involved in the construction of the planimetric map are assembled and registered by application of the radial-line technique. The method can be used to assemble prints in

several adjacent strips as well as prints in a single strip (Fig. 10). The only limitation is the requirement that successive prints in each strip have more than 50% overlap and neighboring strips have about 30% side lap.

Step 1. Center points, transferred center points, and flight lines are established for all prints by methods already described.

Step 2. Lateral points are now selected on both sides of all center points. These should be features which can be easily identified and transferred. If a single strip of photos is adequate for the map, these lateral points are selected at a distance from the center approximately equal to the transferred center points. If additional strips of photos are required for the map, the lateral points are located in the side-lap area common to the prints of both strips. The 2 points on each side of the center of the first print should be transferred to the second print, pricked with a needle, and suitably labeled. The same is done for all other pairs of lateral points. Thus each print will ultimately have, besides its own center and 2 lateral points, 2 transferred center and 4 transferred lateral points, or 9 points in all. The first and last print of each strip will lack one set of transferred points. The lateral and transferred lateral points are called "picture-control points."

Once these points have been accurately located and pricked, fine radial lines are drawn from the center point of each print to all picture-control points located on it. These lines need only be in the form of dashes on each side of the needle holes. They can either be ruled directly on the print, or small pieces of masking tape can be affixed on each side of the needle hole on which the dashes can be drawn. Dashes about ⅜ to ½ inch long are usually adequate. For maximum accuracy a needle stuck through the central hole into the drawing board, and another stuck into each of the other holes in succession, act as locating pins against which a straightedge can be registered during the scribing of the radial dashes.

These radial lines, along with the center points, transferred center points, and flight lines, define a network by means of which the several prints can be assembled under the tracing paper into a pattern entirely independent of relief error and virtually free from tilt error. The assembly can be adjusted to the mean scale of the entire array of prints.

Step 3. The points so far established are primarily for the purpose of accurately registering the prints prior to drawing in details of the planimetric map. They will also be useful as key points on the map, but many more will be needed which are selected purely on the basis of their value to the map-making aspects of the job. Such points are called "map-control points" and should include important points that can be accurately identified, such as hill tops, junctions of streams and rivers, road intersections, and township or section corners. In short, they should be the most accurately identifiable points in the area. The number of such points depends upon the accuracy required for the final map, and the ability of the map maker to sketch in intermediate detail. For it is these points, all corrected for relief error by the radial-line method, that will provide the skeleton to which all other detail will be applied.

Map-control points can be chosen and marked either at this stage or later, after the over-all layout has been completed on the basis of the picture-control points. To the beginner the process will be less confusing if map-control points are left until a later stage.

Step 4. The prints are now assembled in approximately their correct positions in order to determine the size of the final map. A piece of suitable tracing material, preferably frosted plastic between 0.006 and 0.008 inches in thickness, is recommended. (See list at the end of this article.) It should be cut somewhat oversize. Lay this sheet over the assembled prints and center it approximately. Mark the central point of one of the middle prints, and indicate the direction of its flight line.

It is best to begin work at the center of the map and work outward since in this way cumulative errors will be cut in half and those that occur will be crowded to the edges of the map where they are less conspicuous and troublesome.

All prints except the central one whose center was marked are now removed in an orderly manner and the central print again registered with its traced flight line and center point. When in position, anchor it securely. Double check its center point, dot the transferred center points of the 2 adjacent prints, and draw in the flight lines accurately.

Using a straightedge and a very finely pointed pencil or ruling pen, accurately trace the radial dashes to the 6 lateral picture-control points. If map-control points have already been marked on the photos, ignore them for the time being. Remove the first print and insert the second one of the sequence, working toward either end of the strip. Register its flight line with the flight line traced from the first print, and its center point with the transferred center point. If the two do not agree, as will frequently happen in rough terrain, it indicates a change of scale between the 2 prints. The second print can either be shifted along the flight line to split the difference, or the *average* separation of *all* center points from transferred center points for the entire series of photos can be employed throughout the process. By use of the latter alternative the scale of the resulting planimetric map is made equal to the average scale of all photos employed in its construction. In rugged country this is by far the best method. After the print is in register, carefully trace the radial dashes to the picture-control points. If any of the radial dashes are found to be too short to intersect those from the first print, extend them with the utmost care and accuracy. Each successive print of the strip is registered in like manner, and its picture-control dashes transferred to the overlay.

It may be found, either in the case of picture-control points or in Step 6 with map-control points, that all 3 radial dashes fail to intersect in a point. This indicates either an error in identification of points, inaccuracy in drawing the radial dashes, or the presence of tilt or scale

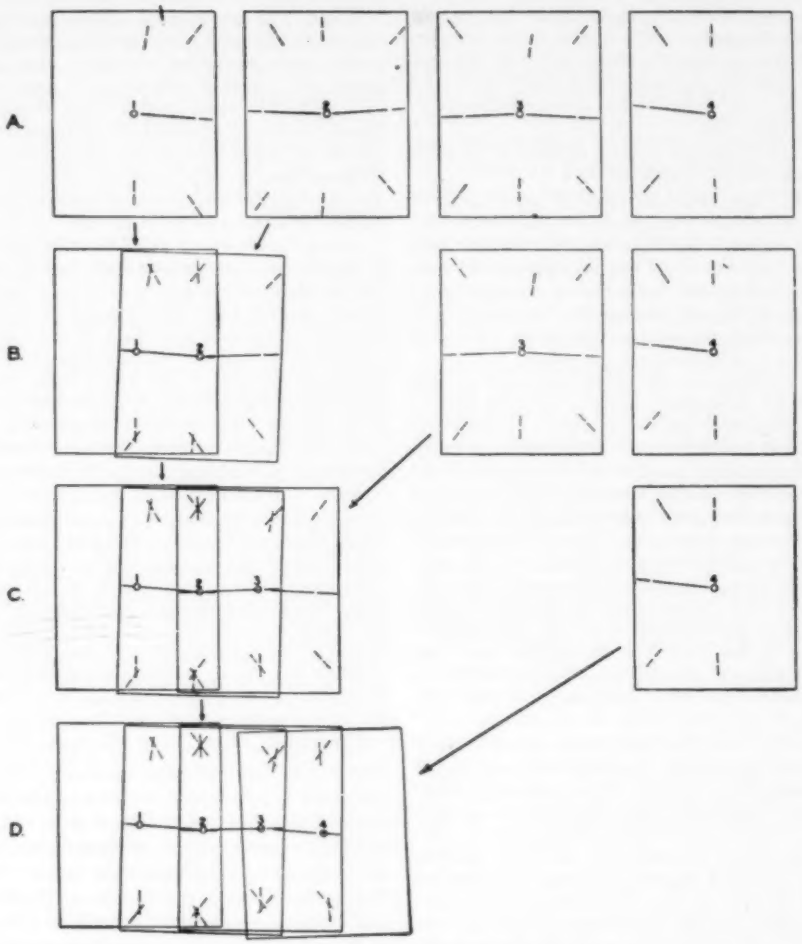

FIG. 10. Picture-point control method of mapping.

A. Four prints provided with center points, transferred center points, flight lines, and lateral picture-control points, ready for assembly under the tracing sheet preparatory to making a planimetric map.

B. Print 2 has been registered by means of its flight line and center point with print 1.

C. Print 3 has been similarly registered. Note that the picture-control points opposite center point 2 agree perfectly.

D. Print 4 has been registered by means of its flight line and center point, but the lateral picture-control points opposite center point 3 show an error; the dashes form a "triangle of error" as described in the text. (Reproduced by permission of Dr. H. T. U. Smith and D. Appleton-Century-Crofts Co., Inc., New York.)

error of exceptionally large magnitude in one or more of the prints. Assuming that no errors are found in the work, and adjustment of the center distances is in accordance with the method recommended in the preceding step, the best procedure to follow is to slide the print along its flight line until a position is found where the 3 intersecting radial dashes to the control points form triangles of equal area.

If photos of only one strip are involved in the planimetric map, proceed directly to Step 6.

Step 5. When additional strips of photos must be added to the layout, it is again best to start with a print near the center. It is, of course, vital that the print chosen to start the second strip be registered alongside the appropriate print of the first series. Adoption in the early stages of the work of a suitable system of marking and color-coding the picture control and center points assures proper identification at this stage.

Transferred center points and flight lines in the lateral direction are nonexistent to aid in the alignment of adjacent strips. It is therefore necessary to proceed with caution until several prints have been made to register both with themselves and with the completed strip. For this reason some readjustment is occasionally required and all marks should be made with a pencil until it is obvious that the second strip is tying in satisfactorily with the first. The proper registration of the first print of the second strip depends upon the superposition of 3 radial lines with 3 fixed points, for the lateral points established by the assemblage of the first strip should be altered to aid the assembly of the adjacent strips only under the most dire circumstances, since this requires the readjustment of the entire first strip from that point onward.

By means of translation and rotation, the first print is brought into registry with the established lateral points of the first strip. Its center and 2 transferred center points are dotted lightly and numbered. The 6 radial dashes to picture-control points are also traced. This print is temporarily laid aside and one of its neighbors is slipped into place, registered by means of the flight line and transferred center point. It is anchored in this position by means of weights while the other print adjacent to the first is likewise slipped into position and registered. By studying the manner in which the radial dashes of these 2 prints align with those of the first, and align or fail to align with the already established points along the edge of the first strip, it is possible to determine in what manner the 3 prints should be shifted to bring them into conformity. If such a change is indicated, make light pencil marks on the overlay to guide in the adjustment, remove all other marks, and begin again.

If all points, transferred points, and radial lines have been accurately made, it should require little adjustment to bring the entire second strip into agreement with the first; likewise, with the third strip of prints on the other side. In case of additional strips, trouble may be encountered and compromises required. But since these errors have intentionally been crowded to the outside of the map, they generally do not require major readjustment of the entire array.

Step 6. The array of prints having been brought into accord, the individual prints must be provided with map-control points if this has not already been done. The greater the number of such points the greater the accuracy of the final result. Radial dashes from the center point of each print to all map-control points are required in order to correct them for relief error. The individual prints are again registered under the overlay, as was done for the tracing of picture-control points, and the radial dashes of map-control points are traced. A minimum of 2 intersecting dashes is required to establish the position of each feature, and the greater the number the greater the accuracy obtained for the position of each feature. As soon as each point is established, it is labeled on the overlay in compliance with the system of identification adopted on the prints in order that it can be quickly and accurately identified on the photos when the task of sketching in ground detail is undertaken. In cases of failure of the 3 sets of dashes to intersect in a single point, the "triangle of error" method is employed, the point in question being assumed to lie at the center of the triangle.

Step 7. After all map-control points have been transferred to the overlay and suitably labeled for identification, details of the terrain are sketched in from the photo, remembering always to use only the central area of each print. Visual adjustment of features suffering from relief error, with the use of the corrected map-control points as guides, can be accurately done after a little practice. The use of a mirror stereoscope will aid in studying details of the terrain in this operation.

Corrected Maps from Groups of Photos: Method 2. Ground-point Control. Still greater precision is obtainable in planimetric maps by the inclusion of ground-control points to provide an accurate scale of dimensions, and an accurate network of reference points to which the layout of prints can be keyed. For details of this method, as well as for further discussion of the picture-control method just outlined, the reader is referred to Abrams (1944, Chs. 13, 14), Eardley (1942: 55-63), and Smith (1943: 159-73); see also Cude (1940), McCurdy (1940), and Massie (1940).

Contour Maps

Contour maps are frequently required in archaeological work, particularly in the neighborhood of sites being excavated. These can be made from suitable aerial photos (scale 1:4000 or less) with a considerable saving in time over the usual method. It is necessary to perform a small amount of field work, but it is only a fraction of that normally involved. The success

of the method depends to some extent upon the availability of aerial photos or enlargements of adequate scale. In view of the fact that contour maps needed to cover the area of most excavations are small in size, the discussion here is limited to the construction of small maps. The reader is referred to the following sources for information on techniques involved in making large-scale maps of this type: Abrams (1944: 92-7, 159-85), Eardley (1942: 38-45), Smith (1943: 198-215), and Blee (1940: 187-90).

The vast majority of contour maps required in archaeological work can be made from one stereo-pair of photos. Only one print is required on which to plot the contours, but the second is needed for use in the stereo-viewer to make relief visible. If the prints are chosen so that the site is near the center of one print, it is rare that the radial-line method of correction for relief error will have to be employed to correct elevations and contours.

For greater ease in plotting elevation points and drawing contours, enlargements on matte-surface paper of the pair of photos are often desirable, particularly in very rough country. But enlargements are difficult to view under the ordinary mirror stereoscope. Therefore an extensible viewer (Eardley 1942: 47) must be employed, which is inconvenient in the field, or the enlargement must be trimmed to a size that is manageable under the normal viewer, if this can be done without cutting into the working area.

The simplest method of contouring involves the use of a Brunton compass in connection with the aerial photos. Along a suitable slope giving the best possible view of the area to be contoured, elevation stations are established either by means of a sensitive altimeter or by means of a vertical-angle traverse. At the adopted stations the compass is employed to spot as many points of equal altitude on the surrounding slopes as are considered necessary. The number will depend to a considerable extent upon the character of the country. As these points are located, they are identified and suitably marked on the aerial photo, using a stereo-viewer if desired. Every fourth or fifth elevation should be identified by a different symbol to avoid confusion in later stages. When a sufficient number of points has been established, the aerial photos are accurately aligned under a mirror-type viewer by means of their flight lines, and contours are drawn in joining all points having a common elevation, giving due regard to the character of the terrain lying between the points. The exaggerated depth perception provided by aerial photos is definitely an advantage in this work. With a little practice it will be found relatively easy to interpolate between observed points. If the contour lines are first drawn with pencil, minor adjustments can be made until the whole array proves satisfactory. The lines can then be inked and the elevation data added.

A more precise method involves the use of a plane-table and telescopic alidade to make the sights. The aerial photo can be affixed directly to the plane-table and aligned with the actual scene — giving due consideration to the effects of relief-error — or a planimetric map constructed from the aerial photos can be employed. Otherwise the technique is the same as for the Brunton compass.

Contours determined by this method can be transferred to planimetric maps. In cases where very rough country is involved, contours can be corrected for relief error by the radial-line method in the same manner as were picture-control and map-control points.

The elevation of individual points can be determined from the amount of displacement of these points due to relief error. Approximate elevations can be obtained by merely scaling prints, as discussed by Eardley (1942: 51-4). More precise methods involving instruments specifically designed for the purpose are discussed by Abrams (1944: 159-85) and Smith (1943: 202-20).

Distance Scales for Aerial Photographs

One of the few disadvantages of aerial photos is the lack of any accurate scale of distances. The vendor gives only the approximate scale on the basis of the mean altitude of the flight and the focal length of the lens employed. When more accurate data are required, it is necessary to establish a scale of distances for each print if the terrain is relatively flat, and for various sections of a single print if the terrain is rugged.

Accurate planimetric, topographic, or even road maps offer a means of establishing a scale of distances when such maps exist for an area in question. The ratio of distances between clearly identified points on the prints and the same points on the map provide a means of

computing the scale of the photo. Several pairs of points, preferably on opposite sides of the center point and at the same altitude should be measured.

If no accurate maps of the area are available, as is frequently the case, it is necessary to visit the scene itself. On level ground, or between points of equal altitude easily identified on the photo, distances are measured. Depending upon the accuracy required, the distances can be determined by means of pacing, taping, measuring with the odometer of an automobile (if sufficiently straight and level roads are available), or by accurate triangulation. In cases where very accurate distance values are required, it is well to establish 2 scales at right angles to each other, passing as nearly through the center of the print as possible. Since photographic paper expands and contracts by different amounts along its 2 dimensions, it is well to have the 2 scales parallel to the 2 sides of the print.

In areas where township and section-line roads or quarter-section fences can be seen, these offer means of establishing a scale. But because sections or quarter-sections are not always of exactly the same size, they should be used with caution.

Procurement and Care of Aerial Photographs

Not all portions of the United States have been photographed from the air. This is particularly true of remote wilderness areas such as prevail over much of the west. The first step, therefore, is to determine whether the area in question has been photographed, and by whom. The best source of such information is:

Map Information Office
Federal Board of Surveys and Maps
North Interior Department Building
Washington, D.C.

Next, write to the recommended sources of photos and request maps indicating the exact extent of coverage provided by each facility, including the designation numbers and dates of flight. Request information regarding types of prints available, cost, and sizes. With this information at hand, select the vendor, if a choice is available, offering the most recent photographic coverage and the type of material most nearly meeting the requirements. If the information already supplied permits listing the prints required *by number*, then all that remains is to send in the order. If, as is usual, the preliminary information has not made available the print numbers, obtain Index Cards or Sheets from which the individual print numbers can be determined.

Be sure to specify in the order the print size, whether contact or enlargements are required, weight of paper stock, type of surface, and any other pertinent information. Most facilities require that payment be enclosed with the order.

All prints should be kept clean and as free as possible from finger marks, stains, and blemishes. Points requiring identification should be recorded by a pin prick and notations made on the reverse side of the print, not on its face. Identification marks required on the face of the print should be made either with a soft pencil, using light pressure to avoid indenting the emulsion, or with India ink which can later be removed with a suitable solvent (consult your local dealer in drawing and engineering supplies).

Prints should never be folded, and should be rolled only when absolutely necessary. In a dry climate photographic paper has a strong tendency to curl and become brittle. Both effects can be minimized by soaking the prints immediately upon receipt in print-flattening solution obtainable at most photographic supply stores. In the field, sand and dust on prints can cause serious abrasion. They should be wiped clean at frequent intervals and either interleaved with soft paper or blotters trimmed to size, or placed in pairs back-to-back in transparent plastic envelopes.

When prints are anchored to a drawing board or joined with tape, make certain to use only crepe masking tape. When removing the tape always strip it from the center toward the edge of the print.

Acknowledgments. It is with a feeling of deep obligation that the writer takes this opportunity to thank several friends for their suggestions and helpful criticisms during the preparation of this paper. My sincere thanks go to Richard H. Jahns, of the Department of Geology, California Institute of Technology; to Harold S. Colton and Edward B. Danson of the Museum of Northern Arizona; and to Robert C. Euler of Arizona State College, Flagstaff.

SOURCES OF AERIAL PHOTOGRAPHS

General Information

Map Information Office
Federal Board of Surveys and Maps
North Interior Department Building
Washington, D.C.

U.S. Department of Agriculture. For information concerning aerial photographs available within its several branches:

Technical Advisory Board
U.S. Department of Agriculture
Washington, D.C.

Department branches dispensing aerial photographs:

Soil Conservation Service
Cartographic Division
Washington, D.C.

Aerial Photographic Laboratory
(Eastern states)
U.S. Agricultural Administration
Old Post Office Building
Washington, D.C.

Aerial Photographic Laboratory
(Western states)
U.S. Department of Agriculture
145 Motor Avenue
Salt Lake City, Utah

U.S. Department of the Interior

United States Forest Service
Department of the Interior
Washington, D.C.

United States Air Force

Photographic Records and Services Division
Office of Research and Liaison
USAF Aeronautical Chart and Information Center
Washington, D.C.

Private Companies

Fairchild Aerial Surveys
292 Madison Avenue
New York City, N.Y.

also

224 East 11th Street
Los Angeles, Calif.

Spence Air Photos
2404 West 7th Street
Los Angeles, Calif.

Aero Service Corporation
236 East Courtland Street
Philadelphia, Pa.

Edgar Tobin Aerial Surveys, Inc.
San Antonio, Texas

Abrams Aerial Surveys
Lansing, Michigan

Pacific Air Industries
Long Beach, California

Holmberg Aerial Surveys Co.
Chicago, Illinois

Standard Aerial Surveys, Inc.
418-426 Central Avenue
Newark, N.J.

National Air Photographic Library
Canada Department of Mines and Resources
Ottowa, Canada

INSTRUMENTS AND MATERIALS

For Use with Aerial Photographs

Abrams Instrument Co.
Lansing, Michigan

Bausch and Lomb Optical Co.
Rochester, N.Y.

Fairchild Aviation Corp.
80-06 Van Wyck Blvd.
Jamaica, N.Y.

Harrison C. Ryker
365 5th Street
Oakland, California

Instruments Ltd.
240 Sparks St.
Ottowa, Canada

Tracing sheet

Kodatrace
Eastman Kodak Company
Rochester, N.Y.

Trace-O-Film
Lustro Company
117-125 East 13th St.
Chicago, Illinois

Local dealers in engineering and drafting supplies.

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No. 21-26 Advanced Map and Aerial Photograph Reading.

Technical Manuals
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No. 5-230 Topographic Drafting.
No. 5-232 Elements of Surveying.
No. 5-240 Aerial Photography.
No. 5-246 Interpretation of Aerial Photographs.

Training Manuals
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Pasadena, Calif.
October, 1956

MIGUEL COVARRUBIAS — 1905-1957

The untimely death on February 4, 1957, of Miguel Covarrubias, one of Mexico's outstanding personalities in Mexican art and anthropology, is a great loss to the country and to science, particularly in the field of museology.

It is not known what incentives attracted Covarrubias' attention, interest, and devotion to primitive and folk art. His training for it was unusual, and unorthodox: his teachers were craftsmen and artists from many countries; his experience was gained in museums, workshops, market places, village roads, or in collectors' houses.

His great talent as a caricaturist won him early recognition and merited fame. His extremely popular drawings in this difficult field were published in many Amer-

(Continued on Page 64)

ican magazines, including *Vanity Fair* and *The New Yorker*. However, he never neglected his own personal interest in art, and thus he wandered into anthropology and archaeology in search of knowledge. He had an amazing store of information on the life, culture, and arts of many peoples of Asia, Africa, America, and many other parts of the world, and an insatiable desire to know the cultures and arts of ancient Mexico.

He attacked problems which perplexed him with his own devices and research methods. It was in this manner that he became involved in the Olmec problem. His enthusiasm for the classic art of the "Olmecs" was so overflowing that he induced his friends to investigate and discuss the cultural enigma of the "Olmecs," which has so puzzled Mesoamerican archaeology.

In 1938 Covarrubias designed and painted the Pacific World mural maps — flora, fauna, people, houses, art forms, transportation, and economy — for the Golden Gate International Exposition, which were later exhibited in New York at the American Museum. In the course of this work he came in contact with many anthropologists working on Asiatic problems. This association renewed his old ideas of Transpacific contacts, which in late years he so often mentioned, and which he wrote about in his book, the first of a trilogy, *The Eagle, the Jaguar and the Serpent*.

There were times when he gave his best to museology, and applied anthropology. He contributed to many different projects or enterprises dealing with native arts: the work of the U.S. Indian Arts and Crafts Board; the exhibitions "Twenty Centuries of Mexican Art" and "Art of North American Indians," presented in the United States at the Museum of Modern Art, New York, and later in Mexico at the National Museum.

It was during this period that Covarrubias came closer to anthropology and anthropologists. The Escuela Nacional de Antropología invited him to give courses on primitive and pre-Columbian art. Considerable patience and persuasion were needed to help him overcome his stage fright. In latter years I often wondered how he could have been so timid. In 1942 the School initiated a training program on Museum Science and Administration. Covarrubias contributed generously with ideas and experience, and thus, was awarded the first appointment in Mexico to teach museology.

In 1946 and 1947 he was asked to cooperate in the reorganization of the National Museum of Mexico. This included a radical change from its previous organization. It also involved planning for a new museum building, which was finished in 1948.

Covarrubias was instrumental in a re-examination of the status of Archaic cultural horizons in the Valley of Mexico. The National Museum initiated an archaeological project in 1947 with explorations in Tlatilco, El Tepalcate, and other sites in the Anahuac Valley, which brought to light a close and intimate association of Archaic material with Olmec types. There were times when he was tempted to force reality, but in the end he always came back to the truth.

His knowledge of the arts of Asia and the South Seas inclined him to a belief in a cultural intercourse and Transpacific contacts between America and Asia. He may not have been able to present sufficient proof, but his insistence drew attention to similarities and parallels in the art of the 2 continents, which, when better understood, may have more significance. His attitude towards these and other problems stimulated the interest and intellectual curiosity of many young anthropologists. The worst that could be said of him as a believer in Transpacific contacts is that he talked too much, knew too much, and felt too deeply.

Miguel Covarrubias became famous and popular while still a very young man. In addition to his reputation as an artist, Covarrubias was equally known as a writer; his first published volume, *The Prince of Wales and Other Famous Americans*, appeared in 1925, and was followed by other books, the best known of which are *Island of Bali* (1937) and *Mexico South* (1946). His last major work, *The Eagle, The Jaguar and the Serpent* was published in 1954.

His success could not mar his deep feeling and support for noble human causes. He rebeled against social injustices; he was loyal to his ideals and to his social and political convictions, which he expressed freely. He fought with all the power of his individuality for any cause he considered just. Obviously, certain things may not have been as he believed them to be, but the fact remains that he was sincere and loyal to his own convictions.

During the last year of his life, Covarrubias' contributions to anthropology and art were invaluable. He was a member of the Arts and Craft Board of the National Museum of Popular Arts of Mexico and helped in its organization. For a few years he was the Director of the Department of Ballet of the Instituto Nacional de Bellas Artes. His influence in this field of Mexican art was productive of many new ideas, and wider concepts of this field of artistic endeavor.

Before he died, Covarrubias bequeathed his priceless collection of pre-Columbian art to Mexico. In this manner the nation inherits the most valuable Olmeca collection in existence, and will thus preserve the spirit of pursuit of knowledge and affection which Covarrubias felt for the Olmecas, and, in general, for all Indian art.

DANIEL F. RUBÍN DE LA BORBOLLA

EDITOR'S NOTE: The photograph of Covarrubias is reproduced through the kindness of Alfred A. Knopf, and the self-portrait through the kindness of Wm. Duncan Strong.

GEORGE GUSTAV HEYE — 1874-1956

George Heye died on January 20, 1957, at the age of 82. He occupied a unique place in the history of New World anthropology, because he assembled the largest existing collection representing the aboriginal cultures of this hemisphere. He also created a museum to house and exhibit it, and he gathered around himself, for a time, a technical staff competent to appraise, publish and increase his collections. Yet later his financial structure collapsed and his staff melted away; thus he had years of difficulty in maintaining the legal stipulations necessary for tax exemption of a public museum. Today, the new director, E. K. Burnett, states that the museum has weathered the financial shoals and is hoping again to expand.

Heye, who came from a wealthy New York family, studied engineering at Columbia and Hamburg, then worked as a railroad engineer in Arizona, where he first came in contact with living Indians and ancient aboriginal artifacts. After a short experience in Wall Street, he decided that he had the financial resources and the bent to devote his life to accumulating the artifacts of aboriginal America.

Heye never studied anthropology but he was not a dilettante and, by experience in handling the material, he became a connoisseur in many phases of native art. Embarked on a career of collecting at a period when there were few anthropologists with formal training (and most of them were tied up by teaching), he sought the best and most experienced help to be had. From 1904 onward, he was not satisfied with mere purchases of specimens, but sent out well-financed expeditions which brought in material with accurate field data — a subject to which we shall return. Heye himself was a member of many early expeditions and helped publish the results. These field trips established the nucleus around which a technical staff was later built.

We shall not trace in detail the development of the Museum of the American Indian, Heye Foundation. Much of the story is contained in a pamphlet entitled "The History of the Museum" (*Misc. Series*, No. 55, 1956). Heye's private collection soon became too large for one individual to handle. Few remember that part of it once was on loan at the University Museum in Philadelphia. At one time, there were negotiations with the American Museum of Natural History in regard to constructing a "Heye Wing," to be at his disposal for life. This fell through because Heye insisted, as was then current practice in many museums, that his collection must always be displayed as a unit.

In order to house his material, Heye rented several floors in a loft building on 33rd Street in New York, where it remained for many years until installed in the present location. Over 40 years ago, when the writer first saw these collections, they were not open to the public and could be seen by invitation only.

Not long after the present Museum was opened to the public, Nicholas Murray Butler, then President of Columbia, and George Heye, a Columbia graduate, had a meeting to discuss the question of amalgamation with Columbia as a university museum. Heye remarked afterwards, "I am Director for Life by the articles of incorporation. Why should I make somebody else my boss?" Probably both institutions still could be strengthened by closer if informal cooperation.

Heye's technical staff stemmed from his offering to finance field trips and publication to individuals working for other institutions, who first came to him on leaves of absence. This was followed by offers of permanent salaries and pensions. Pepper, Saville, M. R. Harrington, Hodge, Skinner, and Cadzow were among the first to join up; there was also a group of great technicians, including Bush, Coffin, W. C. Orchard, and Turbyfill. Since Heye's death, Charles Turbyfill today is the only living individual who has seen the entire contents of the Museum.

We were all of us, I think, drawn towards Heye by the prospect of a new dream museum: hard work demanded, technical skill expected, publication under a great editor (Hodge) assured, financial care for life promised — in days when there were no pension systems for anthropologists. Our group was a harmonious team and productive, as is shown by the list of publications. Among the older men were great scholars of outstanding generosity who shared their knowledge and experience with all.

Heye's story is not entirely one of success, for he was a strong willed character who liked to do things in his own way and did not make full use of the technical help he had assembled. For the guidance of future students, we should point out that the Museum catalog, of which

Heye personally took entire charge for most of his active life, is not what it should be.

For this there are several reasons. In the first place, no field catalog numbers were entered in the Museum catalog and a great deal of information has thus been lost. On the other hand, Heye, if requested, personally added the Museum catalog numbers to the field catalog. Some of these double entries still exist in private hands.

In the second place, nothing is entered in the catalog as "provenience unknown." Saville and the present writer once were shown a small statue of unrecorded type, acquired in a mixed collection without data, and were asked where it came from. One of us guessed Guatemala, the other Venezuela. I do not remember which Heye chose, but a guess was recorded as fact.

Heye had no interest in potsherds — once they were cataloged and added to the count of specimens in the Museum. When the Museum storage was moved to the Bronx, over 70 barrels of sherds were thrown away. So far as is known, there is no record of what was discarded. Some of these sherds came from stratigraphic cuts which had not been published.

George Heye led a complicated personal life, with which we are not concerned. His treatment of some of those who had served him loyally and well is still recalled and resented. On the other hand, others will remember his hospitality, generosity, and understanding. His museum is his monument. For the foreseeable future, no student of aboriginal Americana need leave New York to secure unpublished material for his thesis.

S. K. LOTHROP

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1926 Chumash Objects from a California Cave. *Indian Notes*, Vol. 3, pp. 193-8. New York.

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FACTS AND COMMENTS

FISH REMAINS FROM A SHELLMOUND IN MARIN COUNTY, CALIFORNIA

Through the kindness of Clement W. Meighan, I have been enabled to examine a collection of fish remains obtained from an aboriginal shellmound on Strawberry Point, a promontory on the northwest shore of Richardson Bay, Marin County, California. Richardson Bay, an arm of San Francisco Bay, extends in a northerly to northwesterly direction from Sausalito. A description of this shellmound, and an explanation of the numerical grid system employed in its excavation, have been published by McGeein and Mueller (1955: 52-3, Figs. 22-3), who designated the site "Mrn 20." With commendable thoroughness the excavators saved every bone encountered, and it is thus possible to present an identification of every bone rather than the more usual listing of species from a small, selected sample. This information, when combined with data on size, edibility, and area of occurrence, supplies the archaeologist with usable bases for inferences of dietary practices and environmental potentialities.

Nomenclature. Hubbs and Follett (1953) followed Fowler (1941: 458, 469) in using the name *Holorhinus californicus* (Gill) for the bat ray. Since then, Bigelow and Schroeder (1953: 434) have published information that would seem to necessitate the use of the name *Myliobatis californica* Gill for the bat ray — a usage long employed in the earlier literature. In all other respects, the ichthyological nomenclature employed in this paper is that of Hubbs and Follett (1953).

Anatomical interpretation of the ossified elements of *Acipenser* is that used by Follett (1954). All other osteological nomenclature follows the later usage of Starks (1901, 1923, 1930).

Fishes Represented. The present collection is that mentioned by McGeein and Mueller (1955: 59) as "Fish: remains are not as yet identified." It was taken from 18 stations within the shellmound and comprises 162 fish remains, of which 161 are identifiable. Nine species are represented, all of which, except the sturgeon and the white seabass, are now plentiful in San Francisco Bay and are commonly taken in water less than 10 feet deep. With the exception of the white seabass, the species represented in this collection are undoubtedly those that were most readily caught, by net or by hook and line cast from the shore, in the vicinity of Strawberry Point. The following are the fishes represented:

Smoothhounds — Triakididae
Leopard shark — *Triakis semifasciata* Girard

Eagle rays — Myliobatididae
Bat ray — *Myliobatis californica* Gill

Sturgeons — Acipenseridae
Green sturgeon — *Acipenser medirostris* Ayres (?)

Righteyed flounders — Pleuronectidae
Southern starry flounder — *Platichthys stellatus rugosus* Girard

Croakers — Sciaenidae
White seabass — *Cynoscion nobilis* (Ayres)

Viviparous-perches — Embiotocidae
Redtail surfperch — *Holconotus rhodoterus* Agassiz
Bay blackperch — *Embiotoca jacksoni* Agassiz
Pileperch — *Damalichthys vacca* Girard
Rubberlip seaperch — *Rhacochilus toxotes* Agassiz

Discussion. The leopard shark is commonly marketed for its flesh (Roedel 1953: 18), and by some people is regarded as an exceptionally fine food fish (Cannon 1953: 50, 180). Males have been said to attain a length of 3 feet, and females, 5 feet (Roedel and Ripley 1950: 51). A photograph of this species was published by Walford (1931, Fig. 11).

The bat ray is edible, although now seldom utilized. Several records of its remains in shellmounds of the San Francisco Bay region suggest its aboriginal use as food (Follett 1954). It attains a width of approximately 4 feet, and reportedly a weight of more than 150 pounds, according to Roedel and Ripley (1950: 78). A good photograph of this species was published by Walford (1935, Fig. 56).

The green sturgeon is an excellent food fish. It has been said by Clemens and Wilby (1946: 75) to attain a weight of 350 pounds. The former abundance of sturgeons in San Francisco Bay, their serious depletion by overfishing, and their subsequent slow recovery under legal protection, have been summarized by Follett (1954). This species was figured by Clemens and Wilby (1946, Fig. 30).

The southern starry flounder is a very good food fish (Jordan and Evermann 1898: 2652). Its maximum size is a matter of considerable uncertainty. Lockington (1879a: 254; 1879b: 93, 1879c: 44) stated that examples of this flounder weighing 8, 10, or even 12 pounds were taken in San Francisco Bay but that those sent to the San Francisco market from Humboldt Bay were much heavier. Jordan and Goss (1889: 297) stated that this species attained a weight of 15 to 20 pounds. On the other hand, Orcutt (1950: 14-15, 52) recorded no specimen much in excess of 7 pounds, and stated that a fish of the size mentioned by the earlier authors would now be considered most noteworthy. Roedel (1948, Fig. 106) published a good photograph of this flounder.

The white seabass has been considered one of the most important species in the fresh-fish markets of California (Croker 1932: 325). Nearly a century ago, it was reported as occurring in San Francisco Bay, though not in very great numbers (Ayres 1861: 78-80). It was stated by Lockington (1879c: 26) to attain a weight of 70 or even 95 pounds, and to be taken in San Francisco Bay. Despite the serious depletion of this species since the turn of the century (Whitehead 1930: 25), one or 2 specimens per week were reported taken in the salmon catch in San Francisco Bay as recently as 1936 (Skogsberg 1939: 22). This fish is of seasonal occurrence along the California coast and is seldom taken during the months of November to February, inclusive (Skogsberg 1939: 25-6; Whitehead 1930: 10, 17). The statement by Ayres (1861) that it is taken "from October to March" obviously involves

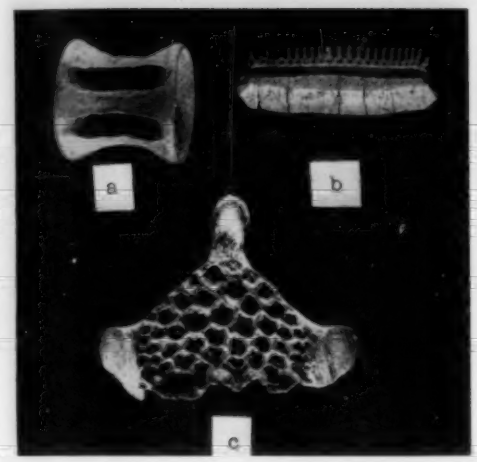

FIG. 1 [Follett]. *a, Triakis semifasciata,* centrum, length 16 mm.; Pit 78, 48″-60″. *b, Myliobatis californica,* tooth segment, length 28 mm.; Pit 44, 48″-60″. *c, Damalichthys vacca,* inferior pharyngeal, width 36 mm.; Pit 78, 24″-36″.

a transposition of those months. It seems probable that even under primitive conditions white seabass were taken only occasionally in the vicinity of Strawberry Point. Walford (1937, Pl. 19) published a figure of this species.

The redtail surfperch appears to be most abundant in San Francisco Bay during January, February, and March. It is a fair food fish and attains a length of more than 15 inches (specimen in California Academy of Sciences, Catalog No. 25832). A figure of this species (under the name *Ennichthys heermanni*) was published by Girard (1859, Pl. 38, Fig. 1).

The bay blackperch is a fair food fish and has been said to attain a length of about 14 inches (Walford 1931: 103). A photograph of this species was published by Walford (1931, Fig. 79).

The pileperch, which attains a length of approximately 16 inches (Roedel 1953: 108), has been of some importance in the San Francisco markets for many years (Eigenmann and Ulrey 1894: 385). A photograph of this species was published by Walford (1931, Fig. 83). The strongly developed inferior pharyngeals of the pileperch are readily distinguishable by their anteroposterior convexity and the large size of their teeth (Nash 1895, Figs. B, C).

The rubberlip seaperch attains a greater size than any other member of its family, reaching a length of 18 inches (Jordan and Gilbert 1883: 596), and a weight of 4 pounds (Jordan and Gilbert 1881: 49). Largely for this reason, it is more highly regarded as a food fish than the other species of its family (Tarp 1952: 56). A photograph of this species was published by Walford (1931, Fig. 84).

FISH REMAINS, BY SPECIES AND SKELETAL ELEMENT

Smoothhounds — Triakididae

Leopard shark — *Triakis semifasciata* Girard
Centrum: 45 (43 complete; 2 fragments); Fig. 1 *a*; the largest from a fish approximately 5 feet in length.

Eagle rays — Myliobatididae

Bat ray — *Myliobatis californica* Gill
Tooth segment: 7 (6 complete; 1 fragment); Fig. 1 *b*.
Centrum: 9, complete.
Caudal spine: 1, nearly complete.
These elements represent fish ranging from approximately 25 to more than 100 pounds in weight.

Sturgeons — Acipenseridae

Green sturgeon — *Acipenser medirostris* Ayres (?)
Pterotic (right): 1 fragment.
Parasphenoid: 5 fragments.
Hyomandibular (left): 1, nearly complete.
Pterygoid (right): 1 fragment.
Subopercle (left): 2 fragments.
Fulcrum: 2, complete.
The elements that are sufficiently complete to permit an estimate of size are from a fish approximately 40 pounds in weight.

Righteyed flounders — Pleuronectidae

Southern starry flounder — *Platichthys stellatus rugosus* Girard
Parasphenoid: 1 fragment, from a dextral example approximately 18 inches in length.
Vertebra: Fragments of 15 (1st to 15th caudal), from a dextral example approximately 24 inches in length.

Croakers — Sciaenidae

White seabass — *Cynoscion nobilis* (Ayres)
Vomer: 2 fragments.
Prootic (left): 1, nearly complete.
Articular (left): 1, nearly complete; Fig. 2.
Maxillary (left): 1 fragment.
Epihyal (right): 1, complete.
Ceratohyal: 4 fragments.
Urohyal: 1 fragment, slightly charred near one end.
Branchiostegal: 2 fragments.
Preorbital (left): 1, nearly complete.
Supracleithrum (right): 1, nearly complete, bearing a knife cut.
Centrum: 2, nearly complete (1st and 2nd precaudal, probably from the same fish).
Caudal (?) ray: 2 fragments.
Several of these elements are sufficiently complete to indicate that they represent a fish more than 4 feet in length.

Viviparous-perches — Embiotocidae

Redtail surfperch — *Holconotus rhodoterus* Agassiz
Inferior pharyngeal: 2 fragments, from fish approximately 12 and 15 inches in length.

FIG. 2 [Follett]. *Cynoscion nobilis,* left articular, length 76 mm.; Pit 80, 36″-48″.

Bay blackperch — *Embiotoca jacksoni* Agassiz
Basioccipital: 1, nearly complete, from a fish more than 12 inches in length.

Pileperch — *Damalichthys vacca* Girard
Inferior pharyngeal: 2 (1, complete, Fig. 1 *c*; 1, nearly complete).
Inferior-pharyngeal tooth: 41, complete.
Vertebra: 2 (6th [?] precaudal and 5th [?] caudal, both incomplete).
These elements are from fish approximately 10 to 16 inches in length.

Rubberlip seaperch — *Rhacochilus toxotes* Agassiz
Vomer: 2, nearly complete.
Parasphenoid: 1 fragment.
Premaxillary (left): 1, nearly complete.
Vertebra: 2 (7th [?] precaudal, incomplete; 11th [?] precaudal, complete).
These elements are from fish approximately 15 inches in length.

Fish Remains, by Station

Pit 41, 48"-60". *Triakis semifasciata*: Centrum (2, Nos. 156, 157).

Pit 43, 24"-36". *Myliobatis californica*: Caudal spine (No. 124).
Acipenser medirostris (?): Subopercle (left; 2 fragments, Nos. 122, 123).

Pit 44, 36"-48". *Myliobatis californica*: Tooth segment (fragment, No. 43).

Pit 44, 48"-60". *Triakis semifasciata*: Centrum (No. 118).
Myliobatis californica: Tooth segment (No. 116; Fig. 1 *b*).

Pit 46, 24"-36". *Triakis semifasciata*: Centrum (4; Nos. 26, 27, 28, 29 [fragment]).

Pit 46, 36"-48". *Triakis semifasciata*: Centrum (9; Nos. 51, 52, 53, 54, 55 [fragment], 85, 86, 88, 98).
Myliobatis californica: Tooth segment (No. 61).

Pit 46, 48"-60". *Myliobatis californica*: Centrum (No. 141).
Acipenser medirostris (?): Parasphenoid (fragment, No. 143).

Pit 46, 60"-72". *Triakis semifasciata* (?): Centrum (No. 147).
Myliobatis californica: Tooth segment (No. 144).

Pit 78, 0"-12". *Platichthys stellatus rugosus*: Parasphenoid (fragment); vertebra (15 fragments; the 1st to 15th caudal).
Rhacochilus toxotes (?): Vertebra (11th [?] precaudal).

Pit 78, 12"-24". *Triakis semifasciata*: Centrum.
Myliobatis californica: Tooth segment; centrum.
Acipenser medirostris (?): Pterotic (fragment); parasphenoid (3 fragments).
Damalichthys vacca: Vertebra (5th [?] caudal).
Rhacochilus toxotes: Vertebra (7th [?] precaudal).

Pit 78, 24"-36". *Triakis semifasciata*: Centrum.
Holconotus rhodoterus: Inferior pharyngeal (fragment).
Damalichthys vacca: Inferior pharyngeal (Fig. 1 *c*); inferior-pharyngeal tooth (15).
Rhacochilus toxotes: Vomer.

Pit 78, 36"-48". *Triakis semifasciata*: Centrum (13).
Myliobatis californica: Centrum (2).
Acipenser medirostris (?): Hyomandibular (left); pterygoid (right; fragment).
Embiotoca jacksoni: Basioccipital.
Damalichthys vacca: Inferior pharyngeal; inferior-pharyngeal tooth (26).
Rhacochilus toxotes: Parasphenoid (fragment).
Undetermined fragment.

Pit 78, 48"-60". *Triakis semifasciata*: Centrum (3; one is No. 5; Fig. 1 *a*).

Pit 79, 24"-36". *Myliobatis californica*: Centrum (4).
Acipenser medirostris (?): Parasphenoid (fragment).
Cynoscion nobilis: Ceratohyal (fragment).

Pit 80, 0"-12". *Holconotus rhodoterus*: Inferior pharyngeal (fragment).
Damalichthys vacca: Vertebra (6th [?] precaudal).

Pit 80, 12"-24". *Triakis semifasciata*: Centrum.
Myliobatis californica: Tooth segment (2).
Cynoscion nobilis: Preorbital (left).

Pit 80, 24"-36". *Triakis semifasciata*: Centrum (2).
Myliobatis californica: Centrum.
Acipenser medirostris (?): Fulcrum (2).
Cynoscion nobilis: Vomer (2 fragments); ceratohyal (2 fragments); branchiostegal (fragment); centrum (2; 1st and 2nd precaudal).
Rhacochilus toxotes: Premaxillary (left).

Pit 80, 36"-48". *Triakis semifasciata*: Centrum (7).
Cynoscion nobilis: Prootic (left); articular (left; Fig. 2); maxillary (left; fragment); epihyal (right); ceratohyal (fragment); urohyal (fragment); branchiostegal (fragment); supracleithrum (right); caudal (?) ray (2 fragments).
Rhacochilus toxotes: Vomer.

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June, 1956

ADDITIONAL EXAMPLES OF AN UNUSUAL PERUVIAN SHIRT TYPE *

In "A New Type of Ancient Peruvian Shirt" (AMERICAN ANTIQUITY, 1955, Vol. 20, No. 3, pp. 263-73) A. H. Gayton described a late period Peruvian shirt (UNMF 15-93) from the Central Coast, collected by Edwin Ferdon of the Museum of New Mexico, especially notable for its horizontal neck opening. The more typical vertical opening has been thought to have been universal in pre-Conquest Peru. The shirt is composed of 3 long narrow webs folded vertically, seamed horizontally, with a horizontal neck slit and short sleevelike extensions closed at the ends but left open along the lower edges (Fig. 1). The 2 lower webs are of very open, almost square count, plain weave of 2-ply natural brown alpaca warps and wefts. The upper and longer one, which forms the shoulder and sleeve section, has the same open construction in natural brown alpaca for something less than half its width; the rest is warp faced in red and slate blue warp stripes.

A survey of the Peruvian textiles in the Division of Archeology of the United States National Museum in Washington, D.C., being made at the time the article was published, revealed 14 fragments representing 12 separate items of apparel (?) that are clearly in the same category as the "Ferdon shirt." All have many details that are similar to the shirt, if not actually identical; but each has certain interesting points of divergence. Five of the specimens were unquestionably parts of similar shirts, others seem to have been, all could have been. Since it will be necessary to accumulate comparable in-

* The authors wish to express their appreciation for the cooperation of the Division of Archeology, United States National Museum, and the Textile Museum in making this study possible.

formation on many such examples before any sound conclusions can be drawn concerning the shirt type, we would like to present what statistical and descriptive information we have been able to glean from the group of specimens in the U.S. National Museum collection. To that end, we have tried to describe briefly what we have found, taking special note of details that are at variance with those of the specimens Gayton discusses. In order to make this information as useful as possible for purposes of comparison, we have attempted to correlate types of data, measurements, terminology, and so on with Gayton's and have followed her study in the use of such designations as "top web" (for the bordered pieces), "folded sleeve end," "fill-in wefts," and so on, and in the numbering of the 1st, 2nd, and 3rd webs as indicated in her diagram (p. 265, Fig. 77).

Of the 14 specimens in the National Museum group, two (U.S.N.M. Lot No. 133043, "Ancon") are of the type of plain brown open-weave web which constitutes the 2nd and 3rd webs of the "Ferdon shirt." One of these is a single complete web measuring 96 inches in the warp direction, 8¾ inches in the weft direction (on a set-up of 101 warp threads). Fragments of 2-ply brown cotton thread (S-spun, Z-plied) occur occasionally at intervals of 1½ to 2 inches along both side selvages, giving evidence of possible sewing or tying to other webs. The other plain, open-weave specimen consists of 2 complete webs, not seamed but tied together along their long edges with lengths of paired wool yarns of the same material and make-up as the warp and weft yarns. Each of these webs measures approximately 96 inches in the warp direction, 10½ inches in the weft direction; but, although the finished width is the same, one of the webs is constructed on 105 warps, the other on 99. The ties occur at intervals along the adjacent selvages. Apparently many of the ties are missing; the intervals between the remaining ones vary from 6½ to 21 inches. The knot is a simple overhand knot with an added half hitch. These specimens seem to equate with U.C.M.A. 4-5903 described by Gayton (p. 269), matching in spin and make-up of yarn, being of similar proportion and nearly identical in warp and weft count. In spite of the considerable length of these specimens, we find nothing about them to indicate a specific use unless as bottom webs of such a shirt as the Ferdon type.

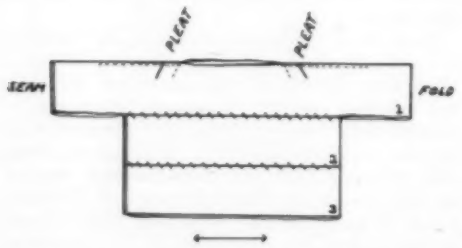

FIG. 1 [Emery and King]. Diagram of shirt type described by Gayton, showing location of pleats noted in U.S. National Museum specimens. Arrow indicates warp direction of all 3 webs.

All the remaining specimens include portions of the 2-color, striped, close-woven borders which Gayton has described in the Ferdon shirt. Two of these (U.S.N.M. Lot No. 133055, "Ancon"), undoubtedly fragments of one web, are so incomplete as to be of no value statistically and are not included in either the tables or the descriptions. The rest have been numbered arbitrarily from 1 to 10, for the purposes of this discussion.

With 2 exceptions, all of the specimens, like Gayton's, fall into the Central Coastal area. Number 1 (U.S.N.M. 307749) is catalogued as from "Coyungo, 40 miles west of Nazca" (also written "Cayungo," on the Rio Grande River, South Coast); and Number 2 (U.S.N.M. 233300) has only "Peru" given as its provenance. Numbers 3 through 10 are all from one "lot" (U.S.N.M. 383139) recorded as coming from a "Ruin on right of Pan American Highway at 130 Kilometers North of Lima near Huacho, State of Lima." Although there is no data available as to associated materials nor about the graves from which these textiles came, it seems reasonable to assume that this shirt type had a rather limited and late distribution.

Numbers 1, 3, 4, and 5 are fragments of bordered webs (3 and 4 belonging to the same web), which cannot be definitely identified as portions of shirts since there is no evidence of either shoulder seam or neck opening in any of them, but their materials, weave structures, colors, pattern, and proportional measurements quite clearly relate them to the shirt group. The accompanying tables show the close relationship.

Number 2 is a nearly complete top web with a complete neck opening, the full length of the top selvage, and parts of both shoulder seams, still intact. The front (?) half is pleated into the shoulder seam with a 2 inch pleat at either end of the neck opening (Fig. 2). The shoulder seams are sewed with running stitches about ½ inch in length of natural tan 2-ply cotton (Z-spun, S-plied) used tripled.

Numbers 6 and 8 are both fragments of seamed top webs, each with a section of one shoulder seam, one pleat, and a section of neck opening, intact. The seaming stitch is the same as on Number 2, but the sewing element is 2-ply brown alpaca like the weft element.

Number 10 differs from 6 and 8 chiefly in having the web pleated into the shoulder seam with 2 contiguous pleats, one 1½ inch, one 1¾ inch. There is only a suggestion of the neck opening beyond the 2 pleats, but the "folded sleeve end" is intact.

Numbers 7 and 9 are the only specimens in this collection which have plain, brown open-weave webs attached to bordered top webs. Number 7 has a 29 inch length of bordered top web with no evidence of pleat, shoulder seam, neck opening, sleeve fold, or loom end. The attached 27 inch length of plain, open-weave web has one finished loom end with 2 paired wefts acting as loom strings and 4 more or less compacted wefts. The single point of conformity with the construction pattern

of the complete shirt, and the only real basis for considering this specimen a shirt fragment, lies in the fact that the 2 webs are loosely seamed together with 2½ to 4 inch overcast stitches in such a way that the fragmentary top web extends well beyond the finished loom end of the second web. Number 9 consists of attached fragments of 3 webs, a top bordered web and two of the plain, brown, open-weave variety. The bordered one has one shoulder seam with its one pleat and the folded sleeve end intact; the loosely attached 2nd (plain) web has one finished loom end (complete, but without loom strings or any compacted weaving) and the underarm fold in place; the 3rd (also plain) web has one finished loom end (with 2 paired-weft loom strings), but this web is attached to the 2nd in such a way that the loom end is aligned not with the finished end of the web above it but with the underarm fold.

Gathering together the details, we find that in material, ply, direction and approximate degree of spin, all of these specimens are in very close accord with Gayton's findings. To be specific, the natural brown yarns of the wefts and the spaced warps are 2-ply alpaca loosely Z-spun and S-plied. The dyed yarns of the warp-faced border stripes, which seem to vary little in color except by reason of staining and fading, are also 2-ply alpaca, Z-spun, S-plied. They are of medium tight spin and twist, but in this group of specimens we find more variation in size of yarn (from specimen to specimen and from color to color in the same specimen) than Gayton found. The difference in the sewing thread and stitch is more marked. In 2 instances we found shoulder seams sewed with 2-ply (Z-spun, S-plied) natural brown cotton (in one case used doubled, in the other tripled), instead of the natural brown alpaca yarn. One specimen showed remnants of the same type of doubled sewing thread at the loom end and shoulder, and the remnants of sewing or tying yarn found on the one unattached plain brown web are also paired 2-ply cotton threads, but are S-spun, Z-plied. We found no shoulder seams made with the whipping stitch which Gayton found; instead, straight running stitches (usually approximately ½ inch in length) are consistently used in the stitching of all 5 instances of shoulder seams.

The weave structure is consistent in the National Museum group, and agrees throughout with the Gayton description. The specimens are all plain weave, the warps and wefts widely spaced in the plain brown sections, the red and blue warps in the striped area set close enough to produce a warp-faced plain weave cloth on the same wefts. However, in spite of the marked contrast in the warp setting between the spaced-warp areas and the warp-faced areas, we can think of no good reason for assuming any variation of heddling arrangement from one area to the other. In regard to warp-end finish, we found 10 instances of the use of 2 paired wefts as loom strings; 3 others of varying warp-end detail, such as compacting of wefts; and only one instance of a finished warp-end with no variation from the body of the weaving. This is in contrast to Gayton's finding of "no specific treatment given at the warp ends" (p. 269). Although we found no separate bowlike hanks of yarn attached to the webs, as Gayton describes; in 2 specimens extensions of the loom strings were folded into small hanks and firmly bound with the sewing thread. We found "fill-in" wefts in only 3 specimens. We failed to find compacted warps along any side selvages, but did find them at the edge of the spaced-warp weave adjacent to the warp-faced border weave in one specimen.

FIG. 2 [Emery and King]. Section of bordered web (No. 8), showing pleat and portion of shoulder seam. Arrow indicates warp direction. (Photograph courtesy Smithsonian Institution).

Whereas Gayton states that, to the best of her knowledge, "the possibilities of shaping garments by gathering, pleating, or stitching folds into a flat cloth were not attempted" (p. 265), we found at least one pleat or fold (and in one case 2 adjoining pleats) stitched into every identifiable shoulder seam close to the neck opening (Fig. 2). The pleats have the effect of fulling what is presumably the front of the shirt onto the back which lies flat.

Furthermore, the National Museum group of specimens shows considerably less consistency in over-all and relative widths in the bordered webs than Gayton found. Reference to the accompanying tables will show that there is, here: (1) greater variation in the over-all width of the webs (bordered webs in the National Museum group range from 6⅜ inches to 11 inches); (2) less standardization in the relative widths of the stripes that make up the border; (3) less constancy in the ratio of border width to total width.

It is impossible to compare the ratio of actual widths since Gayton gives only the number of warps in each stripe, not the linear measurement, and the lack of correlation between the number of warp threads and the linear dimension in the National Museum group can be seen in Table 2.

TABLE 1. WIDTHS OF THE BORDER AND OPEN-WEAVE SECTIONS IN THE TOP WEBS

(Widths in inches, number of warp threads in parentheses)

Specimen No.	Total Width	Border Width	Open-Weave Width
1	11 in.	4¾ in. (174)	6¼ in. (51)
2	7¼ in.	3¾ in. (110)	3½ in. (29)
3	6⅜ in.	3¾ in. (124)	2⅝ in. (23)
4	6⅜ in.	3¾ in. (124)	2⅝ in. (23)
5	6⅝ in.	3⅜ in. (154)	3 in. (35)
6	7¼ in.	3⅜ in. (109)	3⅞ in. (29)
7	7¼ in.	4⅛ in. (156)	3⅛ in. (35)
8	7 in.	3½ in. (136)	3½ in. (27)
9	7 in.	3⅛ in. (124)	3⅞ in. (28)
10	6¾ in.	3¼ in. (136)	3½ in. (30)
UNM F 15-93	8 in.	? (138)	? (?)

TABLE 2. NUMBER OF WARP THREADS IN THE STRIPES OF THE BORDER SECTIONS

(Widths in parentheses)

Specimen No.	Brown	Red	Blue	Red	Blue	Red
1	0	104 (2½ in.)	52 (1⅜ in.)	6	6	6
2	2	85 (2¼ in.)	14 (¾ in.)	3	3	3
3	4	76 (2¼ in.)	32 (1 in.)	4	4	4
4	4	76 (2¼ in.)	32 (1 in.)	4	4	4
5	2	110 (2½ in.)	30 (⅞ in.)	6	6	6
6	2	78 (2 5/16 in.)	20 (⅝ in.)	3	3	3
7	2	108 (2¼ in.)	30 (⅞ in.)	5	6	5
8	2	84 (1⅞ in.)	34 (1¼ in.)	6	4	6
9	2	86 (2 in.)	24 (⅞ in.)	4	4	4
10	4	92 (2 in.)	28 (¾ in.)	4	4	4
UNM F 15-93	4	88 (?)	34 (?)	4	4	4

In regard to the original use of the Ferdon shirt type, Gayton holds that "there is reasonable certainty that the garment is not merely grave furniture, it had been worn" (p. 263). While recognizing the fact that the specimens discussed here are too fragmentary to show signs of wear, which Gayton finds in the complete shirt, we feel that it is more reasonable to suppose that it was a product intended for mummy bundle use than that it was intended for ordinary wear. The evidence against its use for ordinary wear lies in the looseness of the whole construction (the open weave and loosely joined webs with sewing stitches sometimes 2½ to 4 inches apart) and the location of the arm openings at the bottom rather than at the ends of the sleevelike extensions. On the other hand, we feel that there is evidence pointing to the possibility that horizontal neck openings may have been associated with mummy bundle use. In the National Museum collection, there are 4 "mummy bundle ponchos" (U.S.N.M. 307804, 365249, 74104, and 412484 from late period coastal sites) which have horizontal neck openings, warps running horizontally in the garment, and for arm holes, only 2¼ to 3 inch openings left in the shoulder seams at the outer edges. Two of these "ponchos" also have shoulder pleats — 74104 having one pleat on each side of the neck opening and 412484 having 3 small pleats on each side. Obviously these "ponchos" as now constructed, could not have been worn. The most plausible explanation for the small, top, "arm openings" seems to be that they were intended for stick or other false "arms" on a mummy bundle. The fact that one of these ponchos (U.S.N.M. 307804) shows clear evidence of having once been put together in more conventional form with the warps running vertically and with a typical vertical neck-opening and later reconstituted in the present form, lends credence to the idea of association of the horizontal neck opening with mummy bundle use. Such an opening would fit more readily (than a vertical slit) over the roughly flattened square shape of the typical false heads of the Central Coast mummy bundles.

Further examples of such ponchos probably exist — as yet unreported — in many collections, as well as unreported pieces of the Ferdon shirt type. Accumulated evidence will in time tend either to corroborate or disprove the propositions: (1) that the Ferdon shirt type may have been specifically designed as grave furniture; (2) that the horizontal neck slit may be specifically associated with mummy bundle use.

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MARY ELIZABETH KING
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THE NEW MEXICO PROGRAM IN HIGHWAY ARCHAEOLOGICAL SALVAGE

The vast program of highway construction which our country has undertaken creates an urgent problem for all archaeologists, for the construction of these new highways will result in major changes in the roadways of every state and the inevitable destruction of great sections of our archaeological resources. This destruction need not result in the loss of scientific data, however, for the Eighty-fourth Congress included archaeological salvage as

an integral part of the expanded highway program. The pertinent portion of the 1956 Highway Act is as follows:

84th CONGRESS 2d SESSION

Report No. 2436

Federal-aid Highway and Highway Revenue Acts of 1956

Section 120

Archaeological and Paleontological Salvage

Funds authorized by this title to be appropriated to the extent approved as necessary by the highway department of any State, may be used for archaeological and paleontological salvage in that State in compliance with the Act entitled "An Act for the preservation of American antiquities," approved June 8, 1906 (34 Stat. 225), and State laws where applicable.

To assist highway officials and archaeologists in administering and interpreting this section of the law, the Commissioner of Public Roads has issued a Policy and Procedural Memorandum (20-7) which sets forth the responsibilities of both the highway and archaeological agencies in conducting highway salvage archaeology. It appears below as an appendix. To archaeologists the most important features of this memorandum are the authorization for the use of Federal funds to pay a percentage of the cost of all archaeological salvage within the construction limits of Federal Aid highways, and the restrictions against the use of those funds for the necessary preliminary surveys and subsequent analyses of the materials salvaged. All salvage work must be confined to the "road prism," or a designated materials pit, but approved items of cost include salaries, wages, travel, and other expenses incurred while performing the salvage work.

Because of varying local regulations and procedures, the details of operation of a program of salvage archaeology will be different in each state, but the fundamental principals will be similar, and for this reason, a description of the operations of a program of highway salvage archaeology in New Mexico may be of interest to archaeologists in other areas. This New Mexico program, perhaps the first systematic operation of its kind, served as the basic pattern for the Bureau of Public Roads policies regarding highway salvage archaeology.

The conversations which led to the New Mexico program were initiated by a lecture which I gave in March, 1954, to a Santa Fe service club on the El Paso Natural Gas Company's pipeline archaeological salvage program. At the conclusion of the talk I chided the New Mexico Highway Department for their failure to comply with the State and Federal statutes concerning the preservation of our archaeological remains. I confess that my remarks were little more than spur of the moment comments, probably resulting from recent discussions on this subject with Franklin Fenenga, a colleague on the pipeline proj-

FIG. 1 [Wendorf]. View of highway salvage archaeological excavations conducted by the New Mexico Highway Department and the Museum of New Mexico on State Highway 42, 10 miles east of Corona, New Mexico. The site, LA 2945, is a late Pueblo III village. (Photograph by courtesy of Museum of New Mexico.)

ect. Unknown to me, but fortunately for archaeology, the New Mexico District Engineer for the Bureau of Public Roads (United States Department of Commerce), W. J. Keller, was in the audience. Keller had long been interested in archaeology and had been deeply concerned by the destruction of archaeological materials by highway construction. In a later conversation, Keller agreed to cooperate with the Museum of New Mexico in salvaging archaeological materials on the construction projects by the Bureau of Public Roads and to justify these expenditures by reference to the New Mexico and Federal antiquities acts (Laws of New Mexico, 1931, Ch. 42, pp. 31, 34, Stat. 1 L. 225, approved June 8, 1906). Keller further offered to arrange for a conference with officials of the New Mexico State Highway Department for the purpose of discussing the possibilities of a similar agreement with their organization. After clearance with Director Boaz Long of the Museum of New Mexico, a meeting was arranged (April, 1954) and was attended by C. O. Erwin, the State Highway Engineer; T. B. White, Construction Engineer; I. B. Miller, Maintenance Engineer; L. D. Wilson, then Administrative Engineer, now State Highway Engineer; L. H. Miller, Construction Engineer for the Bureau of Public Roads; J. L. Nusbaum, Senior Archeologist, Department of the Interior; Keller; and myself. Keller had previously discussed the problem with the state highway officials and found them sympathetic; thus agreement was reached almost immediately. Erwin, like Keller, had long been interested in archaeology and had an extensive personal collection.

The agreements between the Museum of New Mexico, the Bureau of Public Roads, and the State Highway Department were informal, oral, and subject to modification by all parties. It was understood that this was an experiment; we did not know either the cost of such a program or if procedures satisfactory to all concerned could be devised, but the essential, and still standing, features of this agreement were as follows: (1) that the New Mexico State Highway Department (or Bureau of Public Roads) would provide the necessary labor and heavy equipment needed to salvage the archaeological sites threatened with destruction by highway construction; (2) that the Museum of New Mexico would provide trained personnel to supervise the surveys and excavations; (3) that all requests for labor assistance would be kept to an absolute minimum necessary for scientifically acceptable results; and (4) that salvage would not interfere with the normal progress of construction.

The major problem in operating this agreement was in the coordination of activities, for all projects involving major right-of-way changes had to be inspected, and if archaeological remains were encountered these had to

FIG. 2 [Wendorf]. Remains of a small kiva excavated by the Museum of New Mexico on a highway project near Taos, New Mexico. The rest of the site, located on a small hill nearby, had already been destroyed in previous road grading. (Photography by courtesy of Museum of New Mexico.)

be excavated prior to the time that the contractor was ready to work in that area. In New Mexico contracts for highway construction are awarded each month, and the number of projects varies from five to fifteen depending upon funds available and the costs involved. Normally, these projects are widely scattered around the state, and most of them required an on-the-spot clearance by an archaeologist. Forunately, not every project contained archaeological remains, but they were present often enough to result in the excavation of 40 sites during the first 2 years that the project was in operation.

To assist in making these widely scattered surveys and excavations, the Highway Department provided the Museum with a priority schedule listing the order of construction for projects several months in advance, and arranged for the Museum to receive their regular monthly advertisements for bids. At various times during the month the Highway Department would contact the Museum and inform them that the planning of certain projects had proceeded far enough to justify clearance. As soon as possible the plans for these projects were inspected in the highway offices. Usually many projects could be eliminated at this stage; they involved no right-of-way changes or were entirely urban and not likely to encounter archaeological remains. Field plans for the remainder were obtained, and these, together with the surveyors reference stakes were the guides for the field inspections.

The costs of these surveys were borne by the Museum of New Mexico and represent the major expense of the program to that organization. While costly, they are nevertheless essential, for the highway officials rightfully insisted that the archaeologists could not expect highway personnel to be able to recognize the often far from obvious indications of important archaeological remains nor would they or their contractors tolerate inconvenient and expensive delays in construction while awaiting the tardy arrival of Museum personnel. The archaeologist who waits until a highway employee notifies him of the presence of ruins will erroneously conclude that highways rarely expose archaeological remains.

The excavation of the sites located by these surveys was accomplished with the aid of laborers provided by the highway department and supervised by archaeologists from the Museum. Arrangements for the labor assistance were made directly with the District Office in the area concerned. When a site was encountered on a construction project, the appropriate District Engineer was notified and provided with an estimate of the amount of assistance, in both men and equipment, required for the necessary salvage operations. The District Engineer could draw on any of 3 sources in providing us with our requested assistance. (1) If the contractor was in the area, the labor and equipment could be obtained from his crews on a special work order issued by the Project Engineer. The contractor was later reimbursed according to a standard schedule. (2) The District Engineer could authorize the project engineer to hire the necessary men and pay them out of funds available to his office. (3) The District Engineer might instruct a nearby maintenance crew on their regular payroll to assist in the excavations. This latitude of operation freed the archaeological operations considerably, for it permitted excavations to be made on projects some months in advance of actual construction. This was possible primarily because the New Mexico Highway Department did not desire to use federal aid funds for these salvage excavations; the sources of labor and time of excavations would have been more closely controlled by Bureau of Public Roads procedures. Officials in the New Mexico Highway Department took the view that the expenditures involved were not sufficient to justify the possible inconvenience of federal aid restrictions in operation, but had we encountered a large ruin requiring expensive salvage operations, then federal aid participation doubtless would have been requested.

The amount of federal aid assistance available for salvage archaeology was dependent on the classification of the road under construction. In New Mexico almost all improved roadways are constructed with the combined use of state and federal funds and these are divided, as in other states, into 3 categories, as part of either the federal aid primary, secondary or interstate systems. In most states cost of construction on federal aid primary and secondary roads is evenly divided between the state and federal highway funds. On the interstate system the federal aid share is 90%, and the cost of the archaeological salvage would be similarly apportioned. But because New Mexico is a so-called "Public Lands State," the federal aid share is slightly increased, to 64% on primary and secondary roads and 95% on the interstate system.

The operation of salvage archaeology on projects constructed by the Bureau of Public Roads was slightly different from those involving the State Highway Department. The majority of these Bureau projects went through national forests, or were access roads for the Atomic Energy Commission, and were constructed entirely with federal money. The preliminary surveys for most of these projects were made several months in advance of construction and the estimated costs of all salvage excavations were carefully calculated and included as a part of the contract specifications for that job. While procedures were available to increase these funds in the event that the archaeological remains proved more extensive than had been estimated, care was taken, nevertheless, to make the estimates as accurate as possible. The ensuing excavations on these jobs were timed to begin shortly after the awarding of the construction contract, usually in the interval of a week or two between the arrival of the contractor and the beginning of active construction when the heavy equipment and men were being assembled. Most of the salvage archaeology had to be accomplished during this period if delays in construction were to be avoided.

A very important difference between the Bureau and state highway projects was in payment of supervisory personnel. On the state highway jobs the archaeologists were on the payroll of the Museum of New Mexico, but on the Bureau projects the supervising archaeologists were, on occasion, temporarily placed on the contractors

payroll at foremen's wages. These salaries were included in the construction agency's cost for the archaeological salvage. A similar arrangement would have been permitted by Bureau policy for the "state" projects had the Highway Department chosen to utilize federal aid funds.

Salvage agreements were also concluded with the Regional Office of the National Forest Service, Department of Agriculture. Lack of personnel, however, prevented an adequate survey of the Forest Service's timber access roads, and undoubtedly many ruins were destroyed as a result, although the Forest Engineers were alert for possible sites and did report several ruins which were salvaged. The procedures in these salvage excavations were similar to those followed in the projects for the Bureau of Public Roads.

With all this activity, including constant travel and excavation, the problem of analysis and publication soon became critical. It was obvious that an overwhelming backlog of unstudied and unpublished material was rapidly accumulating and that without a sizeable increase in staff this accumulation was likely to continue. A partial solution to the problem was the preparation of brief, descriptive accounts of the excavations and the postponement of the interpretative discussion until some unspecified future date. This arrangement is far from satisfactory; not only do we lose the often valuable impressions and ideas which occur to the project personnel during the excavations and analysis of a site, but it also reduces the archaeologist from an analytical scientist to a technician. On the credit side, however, we point out that much of the salvaged data are now generally available and may be used by all interested in the area concerned. The brief reports describing the salvage results are being published jointly by the Highway Department and Museum, utilizing press equipment and personnel of the Highway Department. Volumes 1 and 2 in the series entitled *Highway Salvage Archaeology* have appeared to date.

The primary function of all salvage projects is the recovery and preservation of the threatened scientific resources. In this respect the highway salvage program shares a common goal with other large scale salvage programs such as that done in connection with the construction of dams and large scale irrigation projects. The value of this aspect of the work cannot be minimized. However, highway salvage projects differ significantly from most other large-scale salvage operations in that the selection of areas, sites, or even portions of sites to be investigated are beyond the control of the scientist, and are determined without reference to scientific problems, previous theories, or areas of interest. The highway salvage archaeologist, in time, will assemble a body of arbitrarily accumulated data which represents a series of true cross sections of the archaeological remains in his state and across the country. With these cross sections we can not only add to many research problem areas, but we can also evaluate the selective effects that problem orientation may have in data accumulation in this field.

From the experience of the New Mexico operation it is obvious that the extent of the loss of our archaeological resources through highway construction is far greater than many of us had realized. Fortunately, beginning steps to establish similar programs have already been taken in several states, but even in these states, the most difficult problem to overcome is obtaining the funds to make the necessary routine advance surveys of construction projects and to pay the costs of the subsequent excavation analyses. Although these costs are but a small fraction of the total expenditures involved in a functioning program, they are, nonetheless, beyond the immediate reach of most museum budgets. In many instances the only immediate solution will lie with private sources, but the ultimate answer is to seek additional support from the state legislatures. Legal action will also be required in several states which presently lack state antiquities laws, usually a necessary factor in obtaining state highway support. In the final analysis the development of adequate programs of highway salvage archaeology is essentially a local problem. Federal aid support for the excavations will provide a strong incentive, but the archaeologists in each state must take the initiative in its development.

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March, 1957

Appendix

U.S. Department of Commerce
Bureau of Public Roads

Policy and Procedure Memorandum 20-7
Date of Issuance: October 19, 1956

Subject: Archaeological and Paleontological Salvage

1. *Purpose.* The purpose of this memorandum is to set forth the procedures for implementing the provisions of Section 120 of the Federal-Aid Highway Act of 1956 covering the use of Federal highway funds in archaeological and paleontological salvage in Federal and Federal-Aid highway construction.

2. *Policy.* It is the national policy to have preserved for public use historical and prehistorical sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States. Indian ruins come within this policy. It is a Federal crime to injure or destroy any historic or prehistoric ruin or any object of antiquity on Government lands without permission of the head of the department having jurisdiction over such lands (16 USC 433). Several of the States have somewhat similar statutes.

3. *Definitions of Terms Used.* a. The term "historical objects" as used in this memorandum means archaeological and paleontological objects, including all ruins, sites, buildings, artifacts, fossils, or other objects of antiquity that have national significance from an historical or scientific standpoint for the inspiration and benefit of the people of the United States.

b. The term "salvage" as used in this memorandum, shall mean the salvage of historical objects.

c. The term "appropriate authority" as used in this memorandum, shall mean the Federal or State authorities concerned with the preservation and study of historical objects.

4. *Direct Federal Contract Construction.* a. Historical objects should not be needlessly destroyed or if such destruction cannot be avoided, reasonable action should be taken to obtain all information concerning such objects prior to destruction. When a road location or improvement is in an area where it is anticipated that historical objects may be encountered, the appropriate authority should be advised as early as possible of the exact location of the

road to enable such authority to determine the likelihood of the highway destroying historical objects. If it should appear that the proposed road construction will result in the destruction of the historical objects and it is determined by the appropriate authority that such objects cannot reasonably be removed or otherwise preserved, consideration should be given to possible alternate locations of the highway.

b. If, during the course of construction, historical objects are encountered, the appropriate authority should be notified immediately and steps taken to excavate and preserve the objects if practicable, or if preservation is impracticable, to permit the appropriate authority to obtain and record data relative thereto.

c. Agreements may be entered into with the appropriate authority to pay from Federal highway funds the reasonable costs of salvage work. Extra work orders may be issued to the contractors in this connection, provided the specifications have not required the contractor to cover such work in his unit bid prices. Extra work orders may also be issued in cases within the meaning of "subsurface or latent conditions" or "unknown physical conditions" where such terms are used in the standard contract. Payment for salvage work will be limited to that performed within the roadway prism and any location designated by the Government as a source of material. If a contractor's operations are delayed because of salvage work such contractor would be entitled to an appropriate extension of the contract time. If practicable, the operations should be rescheduled to avoid the section until the removal of the artifacts or the gathering of historical data has been accomplished by the appropriate authority.

5. *Limitation of Expenditures.* Cost of exploratory salvage work prior to the start of construction shall be borne by the appropriate authority. Costs of excavation of historical objects or recordation of data therefrom, whether performed prior to or during construction, may be paid from Federal highway funds. Excavation costs may include costs of protecting and preservation during removal at the site but shall not include the expense of shipping historical objects from the site.

6. *Federal-Aid Construction.* To the extent approved as necessary by the State highway department, Federal-Aid funds may be used to reimburse the States on the usual pro rata basis for the cost of salvage work on Federal-Aid projects performed within the genral limitations set forth in paragraphs 4 and 5.

C. D. Curtiss
Commissioner of Public Roads

THE OKLAHOMA ARCHAEOLOGICAL SALVAGE PROJECT

The stimulus for the development of the Oklahoma Archaeological Salvage Project came from 3 sources: The U.S. Bureau of Public Roads Policy and Procedure Memorandum, No. 20-7; the New Mexico Highway Salvage Program; and the Society for American Archaeology's Committee on Highway Salvage Archaeology. Like all programs it was the result of several stages of growth in which a number of individuals participated.

At the January, 1956, University of Illinois Archaeological Conference, attended by representatives of institutions working in that state, most of the discussion centered about the implications of the then pending Federal Highways Act. The Urbana group later circularized institutions within the central states, among them the University of Oklahoma, concerning the results of these discussions and urged recipients of the conference report to secure support for this legislation. The Oklahoma Anthropological Society, through its president Sherman Lawton, followed this suggestion by pointing out the need for this legislation to all the Oklahoma congressional representatives. With the passage of the Highways Bill on June 29th and the formation of the S.A.A. Committee on Highway Salvage Archaeology, John C. McGregor, who had been appointed regional representative for the central states, again circularized institutions in this area with details of the legislation, its implications for participating states, and a summary of salvage procedures as worked out by Fred Wendorf in New Mexico.

Shortly thereafter S. F. Borhegyi, who had recently come to the University of Oklahoma Museum from New Mexico, together with Sherman Lawton, president of the Oklahoma Anthropological Society, contacted the Oklahoma State Highway Department and a memorandum was issued to all department heads and division engineers requesting that if archaeological material was encountered during construction the University Museum be contacted within 24 hours so that salvage operations could be undertaken.

In September, 1956, upon his return from a year's sabbatical leave abroad Robert E. Bell, archaeologist in the Department of Anthropology, realized that, under the Oklahoma state antiquity law, which designated the Department of Anthropology as the sole licensing agency for archaeological exploration and excavation, implementation of any highway salvage program would fall within the jurisdiction of the department. An interim program was arranged by Bell with university administrative officials, so that a full time archaeologist could be employed for salvage archaeology. Approval for this program was obtained from the Regents of the University of Oklahoma and the project began October 15 with the appointment of the writer.

Officials of the State Highway Department at Oklahoma City were again contacted early in November. These talks with the Chief Engineer, G. H. Bittle, and other department heads, who might be connected with the salvage operation, attempted to establish the type of information needed for archaeological reconnaissance and the methods for obtaining it. It was decided that the Salvage Project should be put on the mailing list of the Highway Department's *Weekly Report of Survey Operations.* This report lists road surveys currently being conducted, their location by county and highway number, the name of the nearest community, the approximate total mileage, and the percentage of the survey complete as of the date of the report. It was felt at this time that the survey report would provide a basis for highway project elimination when the data in the weekly report was compared with the archaeological survey maps which had been developed in the Anthropology Department over a period of years. It was also suggested that aerial mosaic blueprints of these surveyed areas would give further aid during the actual archaeological survey of the selected projects. The Salvage Project would also be provided with the regular monthly reports showing the construction status on all highway projects as well as a set of county maps and, if necessary, the monthly notice of awards and contract lettings.

However, in attempting to work from these data it soon became apparent that the weekly survey report failed to show certain data essential to the efficient operation of the salvage project. For instance, it was not possible to determine which of the many right-of-way surveys were federal-aid projects, nor was the type of construction indicated. Obviously, if these 2 facts were known, many grading, resurfacing, or minor drainage projects could be immediately eliminated from the archaeological reconnaisance. In fact, many of the surveys listed are provisional and final approval is not always obtained. It soon became apparent during this initial trial period that the main problem, from the archaeological standpoint, was the difficulty of evaluating and selecting intelligently from among the numerous state highway construction projects.

In the meantime the District Engineer of the Bureau of Public Roads, E. H. Swick, was contacted. During conversations with him, it was suggested that since all projects involving federal funds channeled through his office, it would be more effective for his office to coordinate the data necessary from the State Highway Department, the federal government, and private contractors. The inclusion of this latter group was especially welcome as many contractors are involved and more than one firm might be employed for a given stretch of road. It was also decided to concentrate on highway projects approved by the Bureau of Public Roads during the initial stages of the salvage project. Only after this backlog was eliminated would proposed surveys be included. Nor would secondary county federal-aid roads be considered at this time as they are usually section-line roads involving grading or resurfacing with little relocation of the right-of-way.

Following this agreement an initial survey was selected, a 4 mile stretch of interstate highway near the Kansas border. Since this contract was to be let within a few weeks, it could be regarded as a pilot project and any "bugs" which might appear could be eliminated from the salvage procedure. Unfortunately the right-of-way ran along high ground at a considerable distance from the main drainages and appeared to be an unlikely site location. So it proved. Nevertheless some experience was gained from the preliminary road survey.

The construction involved a 300-foot right-of-way across 3 section-line roads which separated a series of cultivated and uncultivated fields. Despite the use of an aerial mosaic blueprint considerable difficulty was encountered in following the right-of-way. This difficulty resulted from the plowing up of some stakes and others being lost in the grass of the uncultivated fields. Since the actual plotting of a site under such circumstances might involve revisiting the location and the consequent hundreds of miles of driving, it was decided that where possible the archaeological survey should immediately follow the final, rather than the preliminary, survey of the contracting engineers. Of course, in many cases this will be impossible because of time schedules. Nevertheless, where feasible it will save time, not only in the establishment of precise locations of sites in reference to marked center stakes but it will eliminate time lost by efforts to keep properly oriented.

The next 2 highway surveys were selected again on the basis of letting priority and involved stretches of roadway which had been finally surveyed and staked out at 50-foot intervals on the state standard 120-foot right-of-way. The state highway plan and profile maps make it possible to accurately locate any site found at this stage. To date none has been located although several areas of possible occupation have been noted. These suspect areas were marked on the survey map which accompanies the report of the completed survey submitted to the District Engineer's office. The latter will then ask the state's resident engineer to notify the Bureau office when the sections in question will come under construction. Some such procedure is necessary since a small contractor will often give priority to certain sections of road, these priorities being influenced by traffic, drainage, terrain, and special difficulties encountered. Therefore, it is not possible to designate these sections before construction begins. Likewise, it is possible that borrow pits for road material may be shifted during construction. In these cases the Salvage Project must depend upon the office of the Bureau of Public Roads for information. And in the excavation stage there are a number of details of procedure which will have to be worked out as the project develops.

Recently the Bureau of Public Roads has compiled copies of the program sheets representing all state highways which are to be constructed involving federal funds and those projects for which plans are in the Bureau's office have been indicated. These involve 20 projects and some 90 miles of highway. There are an additional 26 proposed projects on file for later investigation. Of these 40 miles are primary roads pending final approval by the Bureau of Public Roads and 85 miles are secondary roads not yet advanced to construction. This is a total of 190 miles of federal aid roads to be surveyed or eliminated. It is hoped that once this backlog of previous programming has been surveyed it will be possible to keep archaeological reconnaissance up with the 200 to 300 miles of federal-aid highways which are constructed annually in Oklahoma. Thus far 4 projects and some 20 miles of roadway have been surveyed.

It might not be amiss here to mention salvage operations which have been or are being undertaken in fields other than highway salvage. The Oklahoma Archaeological Salvage Project, while primarily concerned with highway salvage, does not exclude other projects if an emergency arises. During the first few months of the project's operation and pending the development of highway salvage procedures one pipeline salvage operation was conducted and negotiations undertaken with the Department of the Navy, the National Park Service, and several corporations.

The first operation was the excavation of an Indian cemetery on the eastern outskirts of Oklahoma City from which 16 burials and some Spiro-type artifacts were removed. The finds were reported by the alert operator of a mechanical ditcher laying pipe for an oil company

near the North Canadian River. Suffice it to say that this information could not have been recovered because of teaching committments by other members of the Anthropology Department had not someone been available during the academic year for salvage archaeology.

A second salvage operation was brought to our attention by the membership of the Oklahoma Anthropological Society at Muskogee, Oklahoma, which is some 160 miles east of Oklahoma City near the Arkansas border. Here a recent industrial drive has brought several eastern firms into the area to build plants along the Arkansas River. Preliminary surveys on both properties in question showed sites which might be related in some way to the Hughes Mound nearby which had been previously excavated by the W.P.A. Negotiations were begun with both companies for excavation permits and, if possible, for financial support. Unfortunately, by the time the various officials in one of the companies had been contacted, plant construction was under way and investigation showed that the old village site had been scooped up by earth movers in leveling the plant site. In the other case it developed that the company was leasing the property from a government agency which was the actual owner. Several months of communication were required to obtain permission to excavate these sites prior to construction. The National Park Service was in this case able to support limited archaeological salvage work on the federal lands. Both of these cases demonstrate that sufficient time, at least several months, must be allowed for negotiations with large corporations or the federal government where salvage operations are contemplated, especially if jurisdiction is not in the state.

These experiences in highway salvage archaeology are presented not as models, but as examples of some of the initial problems involved in establishing a salvage program under the Federal Highways Act in one state. During the Central States Archaeological Conference at Urbana, Illinois, in October, 1956, it was pointed out that every state differs in highway programming procedures, since different political institutions control the highway and archaeological aspects and there are various areas of responsibility for the preservation of state antiquities. Consequently, it seems unlikely that a single nation-wide procedure can eventuate for highway salvage archaeology. In fact, there appears to be some doubt as to whether in all states the pattern of highway location will coincide sufficiently with the prehistoric settlment patterns to justify a salvage program of the preceding type. To date it would seem that the effectiveness of the archaeological salvage programs under the Federal Highways Act will depend upon 3 factors: (1) centralization of the state's archaeological resources and responsibility for those resources in one institution and/or individual (this of course does not preclude delegation of that authority); (2) channeling federal highway programming and construction data for the salvage archaeologist through the local office of the Bureau of Public Roads; and (3) cooperation of the general type and to the extent which exists between the salvage archaeologist and the State Highway Department and the Bureau of Public Roads in Oklahoma.

It will probably take some time to establish the worth of an archaeological highway salvage program in any given state. For while surface surveys may not at first develop much evidence, as in Oklahoma, later construction may reveal subsurface evidence. The time between these first surveys and the construction date may be several years. The next 2 or 3 years will therefore be the test period for the nation-wide salvage program.

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March, 1957

UNFIRED CLAY OBJECTS FROM WATERFALL RUIN, NORTHEASTERN ARIZONA

Waterfall Ruin (N.A. 2676), a cave ruin in the Chinlee Valley about 12 miles south of Poncho House, has been briefly described by Guernsey (1931: 32-6) and was the subject of further excavation by Peabody Museum parties led by Oliver La Farge in 1924 and by the senior author in 1933. A number of modeled clay objects obtained in 1933 are of interest as tending to bridge the gap between the Basketmaker III clay complex and certain later manifestations. The earliest structures at the site are Basketmaker III. The main occupation, characterized by continuous building and rebuilding, was in Pueblo I to early Pueblo II, the pottery being predominantly Deadman's Black-on-red and Kana-a Gray and Black-on-white, with some Black Mesa Black-on-white and all-over corrugated ware. Although a few later sherds occur and the stratification in which clay objects were encountered was in large part much disturbed, it is unlikely that any of them are later than the 10th century.

Basketmaker III Figurines. Two small anthropomorphic figurines (not illustrated) were associated with the earliest structures and can be confidently assigned to Basketmaker III on typological grounds. One is represented by the head and upper portion of the shoulder region, while the other is a female figurine complete except for the head. Both bear typical Basketmaker III punctate decoration.

Babes and Cradles. The babe-in-cradle, Figure 1 *a*, came from fill in a storage bin which also contained Kana-a Black-on-white and sherds of all-over corrugated ware. The flat cradle, 3⅛ by ⅝ by $\frac{3}{16}$ inches, has a hood composed of a flat strip of clay protruding at right angles from the upper rim of the cradle to a height of ½ inch. The lower ends of the hood curve in and serve to hold in place the readily removable babe, a flat, spatulate piece of clay $1\frac{5}{16}$ inch in length. There is no indication that the babe was bonded or tied to the cradle. Lacking even the crude nose ridge characteristic of later examples in the area, the babe would hardly be recognizable as anthropomorphic if it had not been found with the cradle. Other similar specimens include 2 babes (1

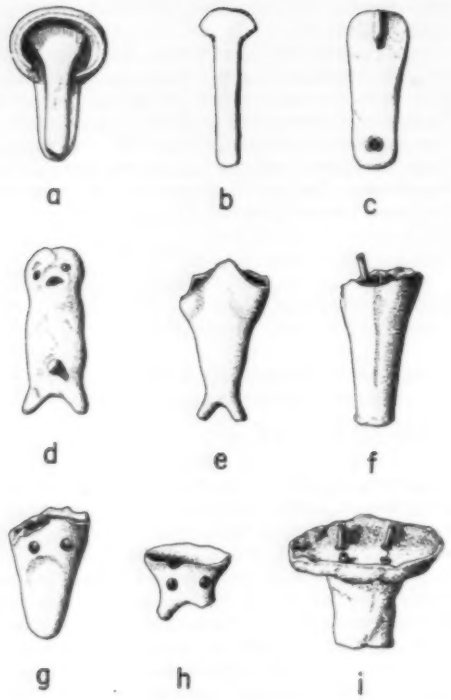

FIG. 1 [Byers and Morss]. Unbaked clay artifacts from Waterfall Ruin, Chinlee Valley, Arizona. *a*, "babe-in-cradle"; *b*, "babe"; *c, d*, figurines, possibly "babes"; *e-i*, carrying baskets. Pueblo I-II, except *g*, which is probably Basketmaker III. (Not to scale.)

shown in Fig. 1 *b*), 2 cradles, and a babe's head as well as several other crude or broken specimens which may be babes or cradles. The 2 cradles do not now have hoods (although they may have been present originally) and have blips of clay on the upper surfaces suggesting that the babe may have been lightly bonded to the cradle.

Other Figurines. Two somewhat more elaborate anthropomorphs are shown in Figure 1 *c* and *d*. The former, 2¼ inches long, has a nose ridge. Near the base is a small, conical depression. The latter, 3¾ inches long, is much thicker (¾ inch) than the usual "babe" type and is coarsely modeled, with deep depressions for eyes and mouth. The eyes were charcoal inserts, of which a fragment remains in the left eye socket. The conical protrusion in the abdomen of this specimen and the hole in that of the preceding specimen would seem, if one may judge from position on such crude figures, to be umbilical rather than genital. If this interpretation is correct, both are simply elaborations on the "babe" theme.

Effigy Carrying Baskets. A small effigy carrying basket, 1¾ inch wide, has 2 holes in the back for the tump line (Fig. 1 *g*) and casual punctate decoration in front. The tip is broken off. It was found in worked-over fill but typologically seems close to such Basketmaker III specimens as that shown in Guernsey 1931, Fig. 26 *a*. The tiny (⅞ inch) bifurcated effigy basket with tump-line holes (Fig. 1 *h*) came from a fallen roof layer which also contained a Kana-a Black-on-white jar. At least 6 other effigy carrying baskets were found which are larger, averaging perhaps 5 inches in original length, and usually very crudely made. Of these, three were definitely bifurcated (Fig. 1 *e*). Most have 2 or 4 sticks protruding from the interior or holes for such sticks (Fig. 1 *e, i*). The broken end of a thick, crude bifurcated effigy basket with 2 sticks protruding 4½ inches at one side was found in fill between 2 floors which also yielded a cradle and 2 babes.

The collection also includes sherds from several unfired clay bowls and dishes as well as fragments of nonrepresentational or now unidentifiable clay objects.

Discussion: Morris and Burgh (1941: 54-6), and, more recently, Judd (1954: 306-20) see the previously utilitarian Basketmaker carrying basket acquiring some cult or ceremonial significance in Basketmaker III times which carried over into the nonutilitarian Pueblo III bifurcated basket. In Basketmaker III both carrying baskets and figurines were modeled in clay, an association which persists in the Fremont culture, probably as late as the 11th century. At Pueblo Bonito, with an 11th century terminal date, both the bifurcated basket and pottery models of it appear, with a very few figurines, and the actual bifurcated basket also turns up at later Pueblo III sites of the Kayenta area. Previously, however, only one actual carrying basket (not bifurcated) and no effigy baskets or figurines have been reported from the Anasazi area in Pueblo I times. At Waterfall Ruin the clay figurine and effigy carrying basket seem to have persisted from Basketmaker III into Pueblo II with the bifurcated effigy basket appearing at some time during this period. At Pueblo Bonito and Pueblo del Arroyo pottery models of bifurcated baskets usually had 4 pottery columns rising from the interior and either terminating in a pair of loop handles or supporting a miniature jar. To these columns the sticks in the crude clay baskets from Waterfall Ruin obviously correspond although no superstructure is preserved in any of the specimens.

The babe-in-cradle with head confined by the incurving cradle hood is found on Kayenta and Tusayan pottery handles, chiefly ladle handles, of the 12th to 14th centuries (Morss 1954: 41). Its occurrence at Waterfall Ruin 2 or 3 centuries earlier as a component of the unbaked clay object complex again bridges a gap in the evidence for a connection already postulated. However, there is no evidence in the Waterfall Ruin material of the multiple bindings across the body of the babe, so suggestive of Mesoamerican influence, which are found on most of the later examples.

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PROBABLE USE OF STONE PROJECTILE POINTS

In recent years there have been some differences of opinion among archaeologists as to the probable use of artifacts shaped like arrowheads but larger than the small so-called "bird points" and ranging in length up to 4 or 5 inches. Some think they are too large and heavy for arrowpoints and must be either knives or spear points. In an attempt to throw some light on this question, tests were made using points varying in weight from that of the smallest "bird points" up to that of spear heads.

Since it is evident that weight is the limiting factor in the use of arrowpoints, several stone points were first weighed. They were typical triangular points from 3 to 4½ inches long, about ⅜ inch thick and from 1 to 1¾ inches wide. Most of them were of flint and a few were of quartzite. The lightest weighed 14.17 gm., the heaviest 40.28 gm. Unfeathered arrows were used in the test, as it was known, from previous experience, that unfeathered arrows fly sufficiently true for the killing of game, if the heads are moderately heavy, and it is also evident that if an arrow without feathers flies true, it will be still more accurate with feathers. Also in considering the probable development of the bow and arrow, it seems quite likely that the earliest arrows were not feathered. Even at the present day, there are some primitive tribes that do not feather their arrows. A mechanical testing machine was not used because of the expense and the difficulty of construction. However, the tests were made by an experienced archer who has shot in several state tournaments. Perhaps this makes the results somewhat subjective but, on the other hand, it is the way primitive man did it.

The first test was with a 25-inch shaft of uniform size and material, weighing 19.5 gm. and with the end sharpened to a point. As was expected, its accuracy was very poor. With such a shaft, the center of gravity is half way between the nock and the head and, during the flight, there is as much air friction on the forward as on the rear end of the arrow. Next, the same shaft was pointed with a bullet jacket weighing 2.4 gm. This placed the center of gravity a little farther forward but the accuracy was still poor. The next head was an empty cartridge weighing 12.8 gm. This put the center of gravity at 17½ inches from the nock. With a bow pulling 20 pounds it gave good accuracy up to 30 feet, fair accuracy up to 50 feet, and with a bow pulling 35 pounds it gave good accuracy to over 60 feet. Tests were then made using increasingly heavier heads. Accuracy continued to increase as the weight of the points was increased until the high trajectory began to interfere. Even with a point weighing 90 gm. it was possible, with a little practice, to shoot quite accurately up to 50 feet or more.

It was also found that accuracy was increased with the greater arrow velocity that resulted from the use of heavier bows. This is because with the center of gravity near the point, the nock end of the arrow acts as a vane to hold the arrow on its course. This steering effect increases as the square of the velocity. This explains why a weak bow may drive an arrow accurately at short distances and fail completely at the longer distances.

The feathers were next removed from a good tournament arrow 28 inches long and the tests repeated. The results were the same except that with the well-made tournament arrow in place of the one made of an ordinary dowel, the accuracy was still greater. In fact, with the tournament arrow and a point heavy enough to put the center of gravity ⅔ to ¾ the length of the arrow from the nock, and using a bow with a pull of 35 pounds, the accuracy was almost as great up to 120 feet as when using a regular feathered tournament arrow. Of course, at greater distances and consequent lesser velocities, the accuracy fell off rapidly. Similar tests with arrows from 15 to 24 inches long gave similar results.

Since accuracy of unfeathered arrows is so largely a matter of balance, it is evident that the heavier the shaft, the heavier the point that can be used. The arrows used in the tests were of relatively light wood and ⅞ of an inch in diameter. Hunting arrows are usually of heavier wood and ⅜ of an inch in diameter, so can use correspondingly heavier points.

From the above, it is evident that stone points up to 4 or 5 inches in length are well within the weight that can be used as arrow points. Whether or not they were so used is difficult to prove but it is quite likely that if they could be used they were; for primitive man, with his limited equipment, was likely to use any tool or weapon that would work. The above also shows that the small points are too light to give the necessary accuracy to arrows unless feathers are also used and it seems improbable that in the early use of bows and arrows the use of feathers was known. In fact, it could well be that in the development of the bow and arrow, the discovery of the use of feathers was about equal in importance to that of the discovery of the use of the greased patch in the development of the rifle.

How the bow and arrow first came into use will probably never be known. Its origin is too far back in the past. It is a matter of conjecture whether its use began at a single center and spread from there or whether the principle of the bow was discovered at different times by different people. However, if we consider the probable way the bow was discovered and developed, it seems most reasonable to think it must have been invented at different times in many different localities. Contrary to the belief of some archaeologists, the principle of the bow was not hard to discover. It was the development into an efficient weapon that was difficult. I once watched a boy about 4 years old discover the principle of the bow and make for himself a little toy weapon. It was many years ago when whips were in common use in driving horses and cattle. The boy had made himself a "play whip" by tying a string to the end of an apple sprout and was playing at driving horses. Tiring of this sport, he began toying with the whip in other ways such as swinging it about his head by the lash. Finally, he took the end of the lash in one hand and the butt of the stock in the other and tied the two together, thus making a crude bow. After plucking the string a few times he picked up a small stick, put one end against the string and projected it a few feet. This appeared to be a new experience and he repeated it a few times with evident pleasure.

Thus, I apparently saw an independent invention of the bow and arrow but at that time I thought little of it as I was little more than a boy myself. Of course, I cannot be sure that the boy had not previously seen a bow but, whether he had or not, he here gave a very probable reproduction of the way the bow was first discovered. It was the way any primitive man, woman, or child could have chanced on the principle of the bow. However, it was a long step between such a toy and the making of an efficient weapon. That could be accomplished only after many experiments and much thought. It may be that for a long time the bow was merely a child's toy until some older person saw its possibilities and made of it a worthwhile weapon.

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November, 1956

RADIOCARBON DATES FROM AN EARLY ARCHAIC DEPOSIT IN RUSSELL CAVE, ALABAMA*

During recent excavations in the archaeological deposits in Russell Cave, Jackson County, Alabama (Miller 1956), we reached a depth of 13 feet. From this level we collected a large sample of charcoal found in association with chert projectile points whose shape suggests a placement at the end of paleo-Indian times and the beginning of early Archaic times.

This charcoal was placed in 3 separate glass containers. One was sent to J. L. Kulp at the Lamont Geological Observatory, the second to H. R. Crane at the Michigan-Phoenix Project Radiocarbon Laboratory, and the third to Meyer Rubin of the United States Geological Survey Radiocarbon Laboratory.

In September, 1956, the Lamont Laboratory sent us a determination of 8160±300 years (6204±300 B.C.) on sample L-344. Recently, a recalculation was made, taking into account slight revisions of background and control data, based on a review of all measurements over the past year and a half, resulting in a new age of 7950±200 years (5994±200 B.C.)

In February, 1957, we received from the Michigan Laboratory an age determination of 8560±400 years (660 ±400 B.C.) for sample M-590. This establishes 2 dates for material from the 13-foot level with a difference between them that does not appear archaeologically significant. Because these 2 dates are so close it was not considered necessary to assay the third sample.

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Carl F. Miller
Bureau of American Ethnology
Washington, D.C.
February, 1957

* Published with the permission of the Secretary, Smithsonian Institution.

REVIEWS

EDITED BY RAYMOND H. THOMPSON

Method and Theory in American Archeology: An Operational Basis for Cultural-Historical Integration. PHILIP PHILLIPS AND GORDON R. WILLEY. American Anthropologist, Vol. 55, No. 5, Pt. 1, pp. 615-33. Menasha, 1953.

Method and Theory in American Archeology II: Historical-Developmental Interpretation. GORDON R. WILLEY AND PHILIP PHILLIPS. American Anthropologist, Vol. 57, No. 4, pp. 723-819. Menasha, 1955.

These articles taken together are in effect a book of something more than 100 pages, and for this reason a review seems appropriate. Moreover, the authors are experienced, productive, and respected archaeologists dealing with fundamental problems, and their views are certainly worthy of serious appraisal. Finally, by publication in the *American Anthropologist* they have addressed their remarks to a general anthropological readership rather than to the more specialized group served by AMERICAN ANTIQUITY. Their essay is likely to be thought of as representative of the theoretical work of American archaeologists, and it is accordingly important to advance contrary opinions if the judgment is not to be lost by default. I hope that the Phillips-Willey articles, the comments already in print (Irving Rouse 1955, On the Correlation of Phases of Culture, *Am. Anth.*, Vol. 57, No. 4, pp. 713-22; Eóin MacWhite 1956, On the Interpretation of Archeological Evidence in Historical and Sociological Terms, *Am. Anth.*, Vol. 58, No. 1, pp. 3-25; W. C. McKern 1956, On Willey and Phillips' "Method and Theory in American Archeology," *Am. Anth.*, Vol. 58, No. 2, pp. 360-1), and this review are no more than the beginning of a lively exchange on theoretical matters. The time is more than ripe for a serious attempt to reach intellectual maturity in our concepts and in the operations stemming from the concepts. It is highly unlikely that any towering figure will appear to set everything straight once and for all; the task is rather one for many contributors, each of whom will present his quota of progress (and no doubt error). The particular merit of the Phillips-Willey contribution is the renewed impetus that it has given to abstract discussion of the methods of archaeology.

As the reader will have deduced from the tone of the preceding paragraph, the central thesis of this review is that Phillips and Willey have not succeeded in making a useful contribution by their attempt "to examine the main lines of theory that have so far emerged in the Americas and to make certain suggestions about future possibilities." The root of this failure lies, I believe, in the near absence in American archaeology of a tradition of competent methodological generalization. American archaeologists have not displayed any great interest in relating their ad hoc techniques to the body of scientific method, and as a result they have not been in a good position to benefit from the wisdom and experience attained in past scientific research. This tendency, said to be characteristic of all young sciences, is exhibited in a pure form in the Phillips-Willey articles, especially the earlier one. It is not even necessary to have any special knowledge of archaeology to show that the authors have not acquired in abstract form the concepts required for any systematic exposition or, for that matter, any successful scientific operation. I wish to emphasize strongly that this assertion does not mean that Phillips and Willey do not know how to do archaeology; it means rather that they are not skillful in talking about how to do archaeology.

A prime example of this failure to integrate archaeological methodology with accepted scientific principles is the idea that "a fundamental unvarying characteristic of all archeological concepts, whether in the domain of artifact typology or cultural taxonomy, is the fact that they are the resultant combination of three unlike basic properties: space, time, and form." This statement is in effect a flat denial of the power to abstract. Since a fundamental operation of science, not to speak of daily life outside of institutions for the mentally disturbed, is the systematic abstraction of dimensions (another term for the "unlike basic properties" of tthe quotation) of things and events from the unmanageable flux of total reality, this denial of the possibility of abstraction would appear to be an inauspicious foundation for a lucid explanation of the rationale of archaeology. Surely rational thinking is somehow involved in our methodology. Form (meaning any physical attribute of the artifact), position in time, and locus in space are indeed necessary aspects of physical existence, and probably all archaeologists would agree that these 3 dimensions are interrelated and essential ingredients in a satisfactory explanation of archaeological phenomena. In fact, archaeology in the narrowly technical sense can be defined as the study of interrelationship of the formal, temporal, and spatial dimensions of artifacts. But an absolutely necessary prerequisite of this study is the abstraction and independent classification of each of these dimensions so that the interrelationships can be perceived objectively. Phillips and Willey have failed to discriminate between the desired end result, a simultaneous 3 dimensional classification (typically of groups of artifacts), and the independent operations requisite to the end result. It is impossible to deduce any meaningful operational principles while laboring under so formidable an incubus.

A direct result of this erroneous concept is the mistake known as "dimensional heterogeneity" in the physical sciences as shown, for example, in the statement that in such concepts as artifact types and cultural units "these three diverse properties may and do vary enormously in proportion one to the other." The statement implies that in a particular instance there may be considerably more time than space or perhaps about equal amounts of form and time, which is precisely equivalent to saying that

something is heavier than it is long or older than it is hot. The fundamental character of dimensions is their discreteness; each dimension has its unique system of scaling units which are literally meaningless when applied to some other dimension. It is at once apparent that statements of the type "15 miles equals 72 degrees Centigrade" or "the house is a mixture of: shingles, 50%; whiteness, 20%; and built in 1917, 30%" are simply nonsense. No rational meaning can be given to the Phillips-Willey idea that archaeological concepts are and must be "mixtures" of form, time and space. Meaningful concepts (and their ancillary operations) either deal with form or they do not, with space or they do not, or with time or they do not. Dimensions, like pregnancy, are all or nothing propositions, and failure to recognize this represents some sort of ultimate confusion. Phillips and Willey argue that "probably a large share of our classificatory difficulties" is the result of failure to recognize the "simple fact" that concepts are necessarily a mixture of space, time, and form. On the contrary, I would conclude that certainly a large share of Phillips and Willeys' classificatory difficulty is the result of not understanding the necessary dimensional basis of classification. This deficiency is something more than a bottleneck in developing a theory of classification — it is a firmly seated cork.

The unfortunate implications of this line of reasoning are clearly exhibited in the discussion of the Midwestern Taxonomic (McKern) system. We are told that the "Midwestern taxonomists . . . seem to be involved in a hopeless contradiction in attempting to set up a scheme so heavily committed to the same factors of phylogenic causality [as the Gladwin and Colton systems], and implied evolution and time, while insisting that it must operate independently of the time dimension." But the McKern system is an explicit unidimensional system, a graded classification of components with respect to formal resemblance. It has no commitment at all to time or space and operates in complete detachment from any implications of evolution, causality, or chronology which the observer may impute to the degree of formal similarity observed. No amount of radiocarbon dating will make 2 assemblages of Hopewell pots look more or less like each other. There are, in fact, only 2 valid reasons for criticizing any classification: the classification in question may not conform to the inviolable rules of classification (for example, fail to divide the entire field) and therefore is not really a classification, or it may be a technically good classification which does not deal with any relevant data (for example, a classification of a group of artifacts with respect to their present temperature). Neither criticism applies to the McKern system — it is a technically good classification, and formal similarity is of primary significance in archaeology. Phillips and Willey have committed the dimensional error of criticizing an automobile because it will not fly. All of this, however, most definitely does not imply that any particular application of the McKern system is above criticism; the individual classifier may not have an adequate technique for measuring the over-all likeness of components, or he may omit significant evidence, or he may extrapolate recklessly from inadequate samples, and so on. The point is that the criticism must be formulated in terms of the same dimension or dimensions as the classification if it is to be cogent.

In addition to these difficulties with abstract dimensions, Phillips and Willey have a second and not unrelated methodological stumbling block connected with what they call "the space-time-cultural continuum." (I cannot resist bringing up the impudent question of whether the lavish use of hyphens was caused by inability to cope with abstract dimensions or whether the hyphens came first and caused the inability.) To clear the way for discussion, there are continua of artifact forms (groups of artifacts which can be aligned so that quite different artifacts at the end points are connected by intermediate forms varying continuously or at any rate by very small steps), time itself is a continuum, and space itself is a continuum. Furthermore, it is sometimes possible to show and always possible to posit a systematic relationship between continua in form and continua in time, that is, a systematic arrangement of artifacts with respect to form turns out to be also a systematic arrangement with respect to time so that the closer the resemblance in form of two artifacts, the smaller the time interval separating their dates of manufacture. The same can be said of the form to space relationship with the added practical note that space, like artifact form, is a given which can be measured directly, and consequently the problems of inference that we encounter in practice in the time to form relationship do not arise in the form to space relationship. It is also possible to show or infer a systematic relationship involving all three dimensions.

The problem confronting archaeologists under these circumstances is that of dividing the various kinds of continua presented by archaeological data. Phillips and Willey feel that in the case of archaeological cultures the classificatory decision is essentially arbitrary — that the resulting culture is merely "a chunk torn loose from the cultural matrix." However, they hold out the hope that it may be possible in the future to achieve a nonarbitrary segmentation by discovering in some manner the classifications made by the peoples whose cultural remains we are studying.

The first difficulty, that of subdividing a continuum, is primarily the result of failure to appreciate what is often called the principle of polarity. If we visualize the problem solely in terms of an alignment of components, each of which differs but little from its immediate neighbors with respect to some continuous scaling system, then we are forced into much the same position as that of Phillips and Willey. If, on the other hand, we consider not only the fact that in the alignment no very great interval separates adjacent components but also the actual tallies of components for each of the scale steps, it may be possible to subdivide the series in a reasonably objective fashion. This principle can be illustrated in skeleton form by imagining a group of components which have been scored on a continuous scale on the basis of formal likeness to some one of the components chosen as the standard of reference and assigned a score of 100

to signify complete similarity. Suppose that a summary classification of the scores yields the following result: scores from 100-90, 15 components; 90-80, 1 component; 80-70, 1 component; 70-60, 1 component; and 60-50, 23 components. It is true that a formal continuum is present because there are tallies in all of the classes, but it is equally true that components tend strongly to be clustered in the 100-90 and the 60-50 classes, and this clustering is just as real a feature of the situation as is the continuity. The 3 components falling in the 90-60 range can be considered transitional between the well-defined clusters at either end of the continuum. The significance attributed to the clustering will be a function of other data; examples of possible explanations are varying rates of culture change through time, shifts of culture type over space for ecological reasons, or conceivably even some remarkably bad luck in sampling. No special discussion of artifact type is required; precisely the same principles apply. I am of the opinion that clustering of this sort is generally characteristic of cultural data and that the development of adequate scaling and analytical techniques for its study is the most important methodological problem confronting archaeologists at present. In any case, to dismiss the problem of dividing continua without discussion of cluster analysis is not at all helpful from an operational point of view. It is interesting to note that cluster analysis is accepted without question by all archaeologists when they are not being self-conscious about methodology; thus the archaeological site (a cluster of artifact loci in the continuum of space) is usually treated as a given.

With regard to the problem of eventually determining archaeo-sociological correlations as an alternative to the artifact type and culture type as an "arbitrarily defined unit or segment of the total continuum," it is necessary only to point out that no such correlations can be made until the problem of classification of archaeological data is satisfactorily treated. It is impossible to relate a specific social unit such as a tribe with a unitless continuum. Rather than being a possible solution to classificatory difficulties, meaningful archaeo-sociological correlation must await the development of nonarbitrary archaeological units. Thus the archaeological application of the concept "community" rests on the prior concept of the artifact locus cluster called a site or component.

This review has so far been concerned with the first of the 2 articles, and within that with no more than 2 concepts. I have argued that these concepts are fundamental and that Phillips and Willey have not dealt with them in an acceptable manner. It would be logical to stop the review at this point, perhaps adding a little terminal muttering about houses built on sand. Or I could continue with derivative ideas with a view to demonstrating that the primary confusion is faithfully reflected at all subsequent levels (I am willing to assert that this is substantially true) and, contrariwise, that all of the good ideas (there are some) are achieved by ignoring the basic premises. Or I could speculate on the influence of intensive seriation studies as a causal agent in the "a culture is just a chunk torn from the space-time-form continuum" notion. What I prefer to do, however, is to return to my original observation that Phillips and Willey are very good archaeologists and to recommend general reading of the second article for its highly competent condensing of a vast amount of empirical data on New World prehistory, interesting juxtaposition of ideas, and honestly described theoretical difficulties. The fact that many of the difficulties are resolvable impairs but does not destroy the substantive contribution; rather it illustrates the gain to be anticipated when the difficulties are removed.

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Ceramics for the Archaeologist. ANNA O. SHEPARD. Carnegie Institution of Washington, Publ. 609. Washington, 1956. xii+414 pp., 59 figs., 11 tables. $6.75 paper, $7.75 cloth.

The importance of technological analysis of ceramics has long been recognized by archaeologists because of the primary role of pottery in historical studies and because "composition of material and nature of techniques combine to make pottery one of the most complex artifacts that early man has left." This complexity has led to the development of complicated and specialized methods of analysis. Although the archaeologist must depend on the specialist to solve his more intricate problems of ceramic identification and analysis, he needs to understand the fundamentals of ceramics and the nature of the available analytical methods in order to formulate fruitful problems for investigation. It is the purpose of this book to contribute to that understanding. A general survey of this sort has been needed for many years.

The first section of this study covers the composition, sources, and properties of ceramic materials, with special emphasis on recent knowledge of clay minerals. The second section describes ceramic processes and the techniques of "prewheel" potters. The author draws ethnological and archaeological data on pottery making almost entirely from the New World. Section 3 is devoted to methods of ceramic analysis and description (physical properties of pottery, identification of ceramic materials, evidence of pottery-making techniques, vessel shape, design analysis). Again, the focus is on New World ceramics. Section 4 covers problems of pottery classification (the type concept, use of punched cards, statistical methods). Regarding the type concept Shepard is squarely on the side of the cultural-functional position as opposed to the empirical position, and she ably defends her point of view with a wealth of examples and ideas drawn from her extensive ceramic experience and understanding.

In the final section the author covers the interpretation of ceramic data (identification of intrusive pottery, use of pottery in relative dating, pottery as a clue to culture contact, pottery and culture history). The discussion of the nature of ceramic change, a question deserving of

more thought and discussion by archaeologists than it has received, is devoted to showing that pottery changes are less continuous and gradual than seriation data indicate. She sees the problem mainly in terms of technological change and pays little regard to the nature of stylistic change or the possibility of trends that might be comparable to linguistic drift. The book is concluded with appendices (including a ceramic glossary and suggestions on field methods for paint identification), a good bibliography, and a useful index.

Shepard says in the Introduction that effective technological analysis leads directly back to the role of the potter, and she feels that this humanistic aspect is one of ceramic technology's most valuable contributions to archaeology. "In stating the role of ceramic technology, I am inclined," she says, "to stress not its accuracy and reliability, not the data it recovers, not even special advantages for determining the sources and relationships of pottery, for these contributions are recognized, in some measure, at least. Rather, I would bring out the fact that ceramic technology places the human factor in proper perspective." This humanistic spirit is felt throughout the book, and no archaeologist can read it without being forced to think about people.

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Man's Role in Changing the Face of the Earth. Edited by WILLIAM L. THOMAS, JR., with the collaboration of Carl O. Sauer, Marston Bates, and Lewis Mumford. University of Chicago Press, Chicago, 1956. xxxviii+1193 pp., 180 figs., 33 tables. $12.50.

This volume is the published result of an international symposium held in Princeton, New Jersey, on June 16-22, 1955, under the auspices of the Wenner-Gren Foundation for Anthropological Research. The sessions, with 53 contributors and 70 participants, were under the cochairmanship of Carl O. Sauer, Marston Bates, and Lewis Mumford. Participants were preponderantly in the biological and physical sciences, but they covered a wide range of fields within these disciplines, and also in the social sciences and the humanities.

Of the 3 sections of the book — "Retrospect," "Process," and "Prospect" — the first two consider what man has done and is doing "to change the face of the earth." The last section evaluates the present over-all status of man and (or in) nature, and his possible future alternatives. Each section includes contributed papers, arranged topically, and a well-edited discussion section.

The book, and the symposium, represent a highly productive synthesis of the varied disciplines involved. It would require a dozen readings in order to digest the full scope of human achievements, and their portent, summarized here. The whole impels new questions by the juxtaposition of diverse elements and viewpoints; it initiates the search for answers in as many directions. This is an attempt at a dynamic, cooperative analysis of man's place in terrestrial life, where easy solutions are lacking. Some of the material is undoubtedly overly familiar to experts in various fields, much of it is controversial, but in the new context every paper has something to say to all readers. The extensive bibliographies which accompany the papers, giving access to many lesser known aspects of man and his environment, are particularly welcome.

Since a short review cannot cover the complete book, comments are limited to those aspects which might concern archaeologists most directly. Part 1, "Retrospect," is the only section likely to provide factual material or syntheses primarily useful to the archaeologist. Here papers by Sauer, Stewart, and the series of papers on developments — especially agricultural — in the Old World are particularly relevant. In "The Agency of Man on the Earth," Sauer introduces the theme of the symposium and moves masterfully from the "primordial condition of man" to the present, in a brief exemplification of his own theoretical approach. Stewart ("Fire as the First Great Force Employed by Man") considers the utility of fire to early man and discusses the earliest archaeological and botanical evidences for its use. He does not seem to be too much at home with the Old World Pleistocene materials (compare Oakley 1956, "The Earliest Fire-Makers," *Antiquity*, Vol. 30, pp. 102-7), nor does he pay much attention to the important pollen analysis work being done by the Scandinavians. Stewart goes on to discuss the long-standing controversy over the origin of temperate grasslands. It is his opinion that fire attributable to primitive man was the deciding factor in their formation and maintenance. Narr ("Early Food-Producing Populations") summarizes some of the European Neolithic cultures (Danubian, Campignian, and the Battle-ax groups), emphasizing settlement patterns, economy, and land use.

Part 2, "Process," is thought-provoking and productive of ideas for archaeological inference and interpretation, although generally concerned with man in the modern world. Here, the sections most useful for archaeologists are probably "Introductory," "Slope and Soil Changes through Human Use," and "Modification of Biotic Communities." These articles contain much factual data on ecological processes and factors important in man's life, and are valuable guides to archaeological thinking about paleoecology in general.

Part 3, "Prospect," concerns all thinking human beings who wonder where man is going and why.

Among the articles directly pertaining to archaeological problems, very few concern the New World, even in part. Sauer includes some pertinent cautions on familiar assumptions as to inferences about early man and Pleistocene climates, as well as a brief discussion of the effects of Spanish occupation on post-Conquest America. Malin ("The Grassland of North America: Its Occupance and the Challenge of Continuous Reappraisals") presents the opposite view from Stewart on the grasslands controversy. He de-emphasizes fire as a factor in grassland formation, and states further that the farmer's plowing of the plains was not nearly so significant as we have been told. Witt-

fogel ("The Hydraulic Civilizations") includes only a few general comments on the New World civilizations. In fact, the symposium is surprisingly deficient in consideration of problems from the viewpoint of the New World, such as changing economic adaptations after the glacial retreat, or the origins of agriculture. Consideration of "Man's Role" in the New World is limited to the period post-1492. (Some comments by Haury, and a few others, however, on archaeological evidence and the ethnographic present appear in the discussion sections.)

Generally speaking, the book considers agriculture and land use, with less emphasis on other resources available to technological civilizations. It pays little attention to other types of subsistence economies. In the considerations of agricultural origins and the spread of a mixed-farming economy, Sauer's hypothesis (the origin of cultivation in Southeast Asia through the use of vegetatively reproductive tubers — *Agricultural Origins and Dispersals*, 1952) is accepted, without representation of dissenting viewpoints (compare Wissmann and others, "On the Role of Nature and Man in Changing the Face of the Dry Belt of Asia"). Neither the important evidence from the Near East nor that from the New World receives much consideration. This seems a serious omission, considering the attention which the book is (justifiably) certain to receive outside of anthropology.

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The Future of Arid Lands. Papers and Recommendations from the International Arid Lands Meetings. Edited by GILBERT F. WHITE. American Association for the Advancement of Science, Publ. 43, Washington, 1956. ix+464 pp., 49 illus. $6.75 ($5.75 to A.A.A.S. members).

The International Arid Lands Meetings, organized under the auspices of the American Association for the Advancement of Science and its Southwestern Division, were held in New Mexico in the spring of 1955. Financial support came from the National Science Foundation, UNESCO, the Rockefeller Foundation, and local groups. An open symposium at the University of New Mexico at Albuquerque was followed by a closed work session at the Institute of Mining and Technology at Socorro.

Although only one of the 69 participants in the Socorro Conference, Pedro Armillas, appears as a professional archaeologist, a fair number of the others are more than casually knowledgeable in this field, as is evident in the present volume.

The end-paper maps show that at least one-third of the earth's land surface is classified as more or less dry. Within such areas the exploring historian, economic biologist, and archaeologist not only cross paths, but inevitably bump into the representatives of modern technology, business, and political life. The scantiness of arid zone vegetation is curiously inverse to the pressure of modern man upon these areas.

Where evaporation predominates over precipitation, soluble nutrient salts accumulate near the surface making land very fertile, provided water can be obtained. In this fact lay the stimulus that prompted man's shift from hunter to farmer, technologist, and city builder. If we except the rice-growers of southeastern Asia, agriculture and consequent arts sprang to vigor chiefly among ancients whose great challenge (and opportunity) lay in the skillful management of water.

Today, when we are trying desperately to deal with population pressure by any means possible except a frontal attack, the ancient glories of the desert take on new interest. Do ruined cities bespeak climates once moister than today, a skill now lost or neglected but recoverable, or the brilliant flash of human enterprise which was inevitably self-defeating? Such are the questions behind the rather numerous references to history and prehistory in this symposium volume.

As Armillas puts it in his brief but excellent chapter on Indian American land use, any mapping of crops and farming ought to be done within historical context since "the local story of trial and error in land management, might help in planning for the future." And Armillas wisely reminds the conference of the principle of anthropology, so basic in conservation, that technical advances can only be made effective by taking account of cultural realities. Would that the wide-ranging projects which today engage such vast amounts of treasure and engineering technology could be tempered by this counsel!

Conference recommendations on archaeology are combined with those on geography and anthropology. Three in number, they emphasize the need for an adequate bibliography, further research on the history of arid land use, and a search for improved procedures in the light of past experience and scientific records.

As matters stand now, the allocation of responsibility for cultural decay in arid lands cannot be clearly established as between climatic change and human malpractice. Evidently the ecological maxim that any region has to be studied on its own merits as a distinct problem applies here. It is certainly clear that the absence of pastoralism in pre-Columbian America postponed a lot of mischief. It is also clear that groupings of unfavorable years within the "normal" pattern of climatic fluctuation can disrupt man's activities. What is less clear is the part played by late glacial and subsequent climatic trends of longer duration. Thus, Tixeront for Africa and Evenari for Israel believe there have been no significant changes of climate during historical times. On the other hand, there is great likelihood that such changes, known to have occurred elsewhere, may have been masked by the results, good or bad, of human activity. For practical, as well as theoretical considerations, our efforts to trace climatic history in detail should not be relaxed.

Finally there is ample reason to respect the soundness of ancient engineering works as a guide to modern rehabilitation. Evenari and Koller speak the sense of the

meeting when they affirm that "archaeological survey has made a most valuable contribution to the solution of practical agricultural problems. The study of archaeology should, therefore, never be neglected in regions where previous civilizations existed in desert areas."

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Archaeology in the U.S.S.R. MIKHAIL MILLER. Research Program on the U.S.S.R., Research Monographs, No. 3, Praeger Publications in Russian History and World Communism, No. 25, Frederick A. Praeger, New York, 1956. 232 pp. $5.00.

This small volume could more accurately be described as a history of archaeological theory and methodology in European Russia from Peter the Great to Stalin, and of the personalities associated therewith. Unfortunately, it is only indirectly a record of discovery and accomplishment. Nor does it cover the crucial developments since the death of Stalin, despite its professed aim to portray "the contemporary position of archaeology in the Soviet Union." (The work originally appeared in Munich in 1954 as a Russian-language monograph; only minor additions appear in the subsequent English translation).

The importance of Miller's book is threefold. It gives, for the first time, the "inside story" of the purging to which Russian archaeology was subjected in the early 1930's — the events whose consequences so distressed and bewildered the late A. M. Tallgren and caused the demise of his famous journal *Eurasia Septentrionalis Antiqua*.. Secondly, the author (a professional archaeologist from Rostov-on-the-Don) is now in the West and free to express his opinions. Finally, it is the first work on the subject available to English readers.

As their horizons broaden, many students of American archaeology are finding it increasingly necessary to take cognizance of archaeological materials in the territory of the U.S.S.R., and thus to utilize, directly or indirectly, Soviet sources. For this growing number, Miller's book should be required background reading, at least for its factual content. Even though the area of greatest interest to us, Soviet Asia, is virtually omitted, nevertheless the trends and currents in Leningrad and Moscow are of decisive importance under the extreme centralization prevailing.

The author's approach to his subject is naturally influenced by certain factors which it is only fair to recognize. As a Ukrainian nationalist emigré, he tends to be anti-Russian as well as anti-communist; and he bears an additional personal grievance, since his brother Aleksandr Miller, a leading academic figure of the 1920's was a victim of the purge. The author was not resident in either of the 2 great centers where major events took place, but seems to have had adequate personal knowledge of developments up until World War II. His information regarding postwar trends after his emigration to Germany is limited to published sources and hence is no better than that available to students in this country. In describing personalities, he is really only at home among the older generation of which he was a part; he has little if anything to tell us about the figures who now dominate the scene — those with whose work and writings we are primarily concerned.

Miller's book will be found helpful in evaluating and interpreting the publications of the different periods through which Soviet archaeology has passed; in discounting the ideological claptrap which puzzles or repels the uninitiated on first contact with Soviet sources; and in understanding the startling vehement personal criticism so evident in Soviet reviews. Perhaps the most useful feature is the description of journals, publications, and archaeological organizations; the publishers are to be commended for inserting the Russian terminology in every case. There is also a handy list of the abbreviations so prevalent in the Soviet literature. A selected bibliography (not wholly devoid of errors) provides a quick survey of archaeological production in the U.S.S.R., but contains nothing of specific interest to Americanists. The book is abundantly documented with notes and is adequately indexed.

Despite his critical attitude, Miller acknowledges the high standard of excellence in technique and scholarship which Soviet archaeology has achieved. Nor can he quarrel with its basic tenet: that remains should be studied only as sources for the reconstruction and understanding of the society that produced them. He points out that, "archaeological science in the U.S.S.R. since 1935 has enjoyed and still enjoys conditions incomparably more favorable to growth than those obtaining in the free world." But the unlimited financial support which only a totalitarian regime could supply has its corollary in complete subordination to the leadership and ideology of the Communist Party.

The concluding chapter, on the postwar years, is the least balanced. The author's implication that recent Soviet archaeology is merely an organ of propaganda and totally unreliable is at variance with the experience of objective students in this country. The reviewer prefers to stand on Shimkin's verdict (1953, *Am. Anth.*, Vol. 51, p. 625): "Severe problems of evaluation exist, but the basic competence and honesty of most Soviet anthropological works seems evident to me."

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Los Orígenes Americanos. PABLO MARTÍNEZ DEL RÍO. 3rd edition. Páginas del Siglo XX, Mexico, 1952 (issued summer 1953). 451 pp., 93 figs.

It has recently come to my attention that this superb book is not even known to most anthropologists in the United States. Possibly this is due to its title, and a general impression that it must deal only with bones, artifacts, and the earliest appearances of man in the New

World. Actually, it is the most comprehensive and most penetrating analysis of the whole subject of cultural development in the New World that has appeared in any language. The term "origins" in this case embraces such varied subjects as: (1) evidences of the original migrations of man into the Americas; (2) supplementary evidence, such as that dealing with trans-Pacific migrations or cultural contributions in later times; (3) cultural comparisons between the New World and the Paleolithic, Mesolithic, and Neolithic stages in the Old World; (4) clues to linguistic and physical affiliations with Old World stocks; (5) agricultural origins and plant geography in both the Old and the New World.

The vast erudition and insight of Professor Martínez del Río are apparent in every chapter of this great work. The first 2 editions, published in 1936 and 1943, were widely read, but in those days there was comparatively little concrete field evidence to discuss in the New World as compared with the Old. Linguists, physical anthropologists, ethnologists, archaeologists, and plant geographers either constructed fancy theories from scant data, or they denied outright that there were any real problems to be discussed between the 2 worlds except the time of earliest migration across Bering Strait. Since World War II, however, a great amount of new research has developed new insights; no single scholar in any country has been able to keep abreast of these developments better than Martínez del Río. The comparison is best seen in the several recent text books in anthropology by American writers, none of whom has been able to treat the subject of "origins" — either racial or cultural — in a manner to equal this book. I mean this to include not only knowledge of detailed evidence, but knowledge of theories and especially the critical evaluation of these theories.

Unlike the first 2 editions, this third one is a full-scale book, printed on enamel paper in attractive format, amply illustrated with both drawings and clear photographs, and clothbound. It is dedicated to the memory of Kirk Bryan. The bibliographies at the end of each chapter include many sources now forgotten by the general reader but worth tracing for the development of ideas about the American aborigines.

The author's mastery over a tremendous range of subjects and his willingness to speak his frank opinions, his subtle sense of humor and his philosophical sidelights, make for delightful reading. To anyone capable of reading the Spanish, which is not too difficult, this book must take its place as the leading work of its kind to appear in the New World.

When I first read it I made a number of notes and questions on statements having to do with specific sites, artifacts, and climatic correlations. However, I learn that Martínez del Río has discovered most of these himself and intends to correct them in an English edition now being prepared.

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Preliminary Classification Outlines. Edited by MAURICE ROBBINS. Massachusetts Archaeological Society, Bronson Museum, Attleboro, 1956. 36 pp., 23 figs. $1.00.

This publication of the Massachusetts Archaeological Society is a collection of papers which have appeared in various issues of the society's *Bulletin*. In the foreword, the editor states that it was prepared in response to the membership's request for back numbers of the *Bulletin* which are now out of print. The foreword also states that this publication is offered primarily for the use of nonprofessional members of the society and that its content has not met with universal endorsement by the society's members or research committees.

Many types of artifacts are dealt with in these articles. In the most extensive presentation (12 pages) "A Proposed Artifact Classification," William S. Fowler discusses projectile points, knives, drills, and gouges. Other papers consider prehistoric and metal tomahawks, agricultural tools, fluted points, atlatl weights, and New England pottery. The conceptual approach varies in the assembled papers. Some are descriptive; others combine description with the function of artifacts. Some are historically oriented while at least one paper is primarily a summary of current information. The illustrations accompanying most of the papers permit the reader to visually comprehend the distinctions made in the text. In this way, the terminology employed, although at times at variance with more familiar designations, is made meaningful. For example, Fowler considers among projectile point forms those which are small stemmed, corner notched, and corner removed. Only by looking at the illustration is one able to learn that his corner-removed forms are what many call stemmed forms. This situation could have been alleviated had the 2 papers to which he continually refers been included in this publication.

The need for a method of describing artifacts has been a real one for years. A survey of the archaeological literature demonstrates that this need has stimulated several to report on systems they have found useful. The earliest of these may be Gerard Fowke's (Bur. of American Ethnology, 13th Annual Report, 1896). In 1947, A. H. Whiteford commented upon this need and described a method he had found useful in working with projectile points (AMER. ANTIQ., Vol. 12, No. 4, pp. 226-39). In spite of the several contributions to problems dealt with in this publication very few bibliographic references accompany the articles and no bibliography is presented. Although I doubt that the authors of these papers were unaware of existing literature, that is the impression that they give.

The question of how the Indian used the various artifacts is given some attention in most of the articles. Certainly this is an ever-present question and one with which the public seems to be greatly concerned. However, positive statements regarding this subject usually disturb me since many artifacts could have been used in various ways. The viewpoints presented here are not unreasonable; it is only that no alternative hypotheses are presented.

This publication should prove helpful to those interested in the New England area. While some of the descriptive terminology differs from that employed in other parts of the northeast, the use of some agreed upon terminology is desirable. In this sense, this publication can serve as a glossary of terms. The Massachusetts Archaeological Society has performed a service to their members and others by making papers of this type more readily available.

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La cerámica arqueológica de Cholula. EDUARDO NOGUERA. Biblioteca de Historia y Arqueología Americanas, Editorial Guarania, Mexico, 1954. 315 pp., 41 figs., 99 pls. (39 in color), 3 tables, 1 chart, 1 map. $150.00 (Mex.).

This study of the pottery of Cholula, site of the largest pyramid substructure in the New World, will be the basic report on Cholula for a long time to come. Stratigraphic excavations undertaken by Noguera from 1932-36, taken in conjunction with the material uncovered in the exploration of the interior and exterior of the great pyramid, form the basis of the report. The stratigraphic pits, usually 3 m. square, excavated normally in 20 cm. levels, were sunk at a number of points around and within the pyramid. Unfortunately, partly because of the manner of presentation, it is often difficult and sometimes impossible to follow the details of these excavations, particularly those undertaken in the tunnels in the interior of the pyramid.

The book is primarily concerned with an analysis of the Cholulteca wares at Cholula but pre-Cholulteca wares (Archaic and Teotihuacán) also are described and illustrated. Observations concerning the significance and implications of the wares described are included in the chapters devoted to their description, but in some cases these observations are curiously at variance with Noguera's final summary and conclusions. Presumably in such cases the final chapter expounds his ultimate views on these matters.

The Cholulteca material is divided into 3 periods, based primarily on decorated wares. In Cholulteca I the influence of Cholula was most powerful and widespread, reaching as far as Yucatán, perhaps by way of Veracruz. It is a period in which plumbate, Mazapan, and late Monte Alban (possibly Period IV) wares are found; it was characterized by close relationships with the Mixteca region, coastal Veracruz, Tlaxcala, and the Valley of Mexico. It is coeval with the first Postclassic cultures in central Mexico. By contrast, directliy demonstrable Cholula relationships in Cholulteca III are almost all with the Valley of Mexico, which is also true of the Archaic and Teotihuacán occupations of the site. In discussing these relationships Noguera is rarely able to arrive at definite conclusions concerning their nature, principally because of the lack of sufficient comparative material of known age from other regions.

The relationship of Cholula to Teotihuacán has long been a major problem. While this book does not solve it, due in part to the nature of the excavations undertaken, it does provide at least a partial answer. From a study of the ceramics directly associated with the pyramid, Noguera concludes that all the structures found within the great pyramid are Teotihuacán in age, but that the great pyramid itself (Structure IV) was built in Cholulteca I, for Cholulteca I materials are found in the upper portions of the fill comprising the great pyramid as well as in the structures built upon it. Until now the great pyramid, the only structure in aboriginal Mesoamerica larger than the Pyramid of the Sun, has been dated as pre-Cholulteca (compare Marquina 1951, Arquitectura prehispánica, *Mem. del Inst. Nac. de Antro. e Hist.* No. 1, p. 129). Only the *Altar de los Cráneos* (Structure V) was assigned to the Cholulteca epoch. This seemed to deny the undisputed dominance of Teotihuacán over much of central Mexico which the enormous influence and extent of Teotihuacán culture during its great period of expansion clearly seemed to imply. Noguera's interpretation would dispose of this problem.

There remains the curious fact the Teotihuacán III (Xolalpan), the period of greatest expansion of Teotihuacán civilization, finds almost no expression in Cholula, either ceramically or architecturally. The other 3 major Teotihuacán periods are represented by ceramic remains, and Teotihuacán II by architectural remains (Structure I-B). In addition Structure I-A is probably Teotihuacán I in age. Marquina comments on the fact that Structures II and III within the great pyramid are not in the Teotihuacán style, nor, for that matter, do they possess demonstrable affinities with any other structures known in Mesoamerica. Noguera does not deal with the problem posed by these architectural remains, but he does discuss the problem posed by the ceramics. He concludes that Teotihuacán culture underwent a period of stagnation at Cholula during which the forms and wares of Teotihuacán II (principally the characteristic black or dark brown ware) continued to be made long after they had been superseded in Teotihuacán itself. This, however, leaves unsolved the stylistic problem posed by Structures II and III, and a still undefined circular structure between Structures III and IV.

In contrast to a break in cultural continuity which he finds at the bottom of the Cholula sequence, between the early Archaic and Teotihuacán I, Noguera postulates a direct development from the Classic to the Postclassic periods in Cholula, that is, from late Teotihuacán into Cholulteca I, probably as a result of stimulation provided by the arrival of a new people, who, however, did not displace but instead fused with the existing population. Out of this fusion developed Cholulteca culture. The principal evidence for this is the continued manufacture of black ware in the first Cholulteca period, accompanied by changes in form. In addition, the technique involved in making the magnificent Cholulteca I lacquer polychrome seems to be derivable from the Teotihuacán *al fresco* decoration process. The dating of the

great pyramid as Cholulteca I provides further evidence in support of this conclusion since enormous pyramidal sub-structures are not characteristic of other postclassic cultures.

Noguera also concludes that Cholula was a city, with a presumably permanent population, at least during Cholulteca times. This is evidenced by the great numbers of sherds of plain domestic wares (more than half of the total number), plus abundant remains of comals, manos, metates, mortars, and so on. The book is magnificently and profusely illustrated, an unusually large percentage of the illustrations being in color. All the colored plates and most of the black-and-white are printed separately on fine paper and pasted into the text. Unfortunately, none of the illustrations are accompanied by scales. Both because of the importance of Cholula and the wealth of material which it contains, there is no doubt that this book will long remain a basic work in the literature of Mesoamerican archaeology.

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The European and the Indian. European-Indian Contacts in Georgia and Florida. HALE G. SMITH. Florida Anthropological Society Publications, No. 4, Gainesville, 1956. viii+150 pp., frontis., 1 chart, 6 maps. $2.00.

At a time when there has come about an increasing awareness of the contribution archaeology can make to problems involving contact situations, this study should prove a welcome addition. Originally written as a doctoral dissertation at Michigan, it sets out to view "the culture change reflected in archaeological materials from the inception of European influences into this area [Florida and Georgia] until the 1800 time period." Within the limits imposed by the available data, the author has achieved this aim.

The paper is organized within the chronological framework which the author has established for the era of European contact in Florida, an Early Period (1500-1600), a Middle Period (1600-1700), and a Late Period (1700-1800). He discusses the historical aspects of each period as it is known from the documentary sources, and summarizes the archaeological data from all of the sites that can be placed within one period. Separate discussions are devoted to English and Indian trade in Georgia, the differences in the nature of the Spanish and English contact with the Indians, and to those sites which are primarily European, such as St. Augustine.

One of the most important facets of the paper is the archaeological demonstration of the reluctance of the Spanish colonial administration to trade with the Indians, a policy which seems to have brought about few if any major changes in the aboriginal culture. This was, for the Spanish, an unfortunate procedure. The English were able to take advantage of the situation, and soon after they began to make trading contact with the Indians they had the upper hand in the Southeast, both politically and economically.

The subtitle and several chapter headings to the contrary, the primary concern of the paper is with that area which is today within the state of Florida. The Georgia situation is noted only incidently, and then primarily in terms of English contacts, in spite of the fact that the Spanish held the Georgia coast for well over 100 years before any English intrusions. The Georgia missions were of major importance to the Spanish and at times were the prime concern of the St. Augustine government. This neglect of Georgia, however, can be attributed more to the absence of published material from workers in Georgia than to oversight on the part of the author.

The most grievous shortcoming of the paper is the lack of illustrations. While some of the material discussed has been figured in previous reports much of it is new. Illustrations of this material would be of enormous value to anyone wishing to do any sort of comparative work. They would also have helped to clarify certain points which Smith makes, such as the influence of European vessel shapes on Indian pottery.

In an area where the Indian-European contact came about at a very early period and the extinction of the native cultures was swift, this study can be recommended as a needed adjunct to the documentary resources.

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Archeology of the Funeral Mound, Ocmulgee National Monument, Georgia. CHARLES H. FAIRBANKS, with Introduction by Frank M. Setzler. Archeological Research Series, No. 3, National Park Service, United States Department of the Interior, Washington, 1956. vi+95 pp., 6 figs., 28 pls., 6 tables. $1.00.

This volume is the third in the National Park Service's new archaeological research series. It maintains the standard set by the first two. Mention must also be made of the skillful editing which is manifest on every page. The work being reported was done in the early stages of the relief-work archaeology sponsored in the 1930's by the Smithsonian Institution. The data have lain unreported, and at times unloved, for many, many years. Most Southeasterners will want the book because most of them have visited, and marveled at, and been curious about, the details of the famous Macon Plateau site just east of Macon, Georgia, in what is now Ocmulgee National Monument.

Fairbanks has pored over the notes, which were sometimes hastily made during the "dragnet" operations conducted by Arthur R. Kelly at Macon with WPA labor. Certain of the notes and map records are either missing or time did not permit their preparation. Despite these difficulties Fairbanks has drawn together a coherent and detailed report of Mound C, the burial mound. Because the original digging was not done under the fullest possible control our information about the position of the funeral mound in the total history of the site is to some extent inferential. None the less there seems to be no doubt that Mound C was a 6 stage pyramidal mound

into which, and under which, numerous burials were made. In the mound there are vertical-walled log tombs, not a common Mississippi trait.

From the general student's point of view the most valuable portion of the publication will be the opening chapter wherein Fairbanks gives a statement of the total chronology of the Macon Plateau archaeological manifestations. Herein he presents somewhat more information than is available in other publications about this sequence of cultures which extends through the occurrence of a paleo-Indian, Archaic, transitional, and Middle Woodland, 3 stages of Mississippi development, to a final historic Creek horizon. The historic horizon is identified with a trading post which was long ago briefly reported (Am. Antiq., Vol. 4, No. 4, 1939). In this section Fairbanks also indicates comparable archaeological complexes found elsewhere. A second section is important to those generally interested in the Southeast; it consists of a succinct but illuminating "Summary of Life on the Macon Plateau." Here we have a rather lyrical and narrative interpretation of the social structure and general behavior of those Mississippi peoples who inhabited the Plateau.

The remainder of the report is concerned with excavation techniques, a description of the physical nature of the mound, and the analysis of the specimens and phenomena encountered. By and large the treatment is satisfactory, and the volume as a whole is a valuable contribution to the Southeastern literature. I am certain that one or another specialist will quarrel with particular sections, or with the interpretations of the data, but in my own knowledge of the material and of the difficulty Fairbanks faced in developing this coherent story, it seems to me that he has done well.

The appendices include pottery type descriptions, a description of whole vessels, sherd statistics (mercifully kept from our eyes in the general report), a rather lengthy trait list wherein the observed or inferred behavior traits of the Macon Plateau peoples are presented in various activity complexes, and a tabular résumé of burials found in funeral mound pits.

Photographic illustrations are only adequate. The book is marred by the printing of several photographs of the exhibit cases in the current Ocmulgee National Monument Museum. These, I think, are not properly included because they are directed at a different audience than will read this book and they are at a different level of communication. They add little to the book unless the National Park Service, because of pride in these exhibits, simply wants to publish some of them and this seemed a good place to do it. If this were the purpose of including these, one can sympathize and agree that their printing is justified. If, however, the inclusion of these pictures was meant to augment or improve an archaeological monographic treatment, I think the purpose was not served.

Setzler, as the coordinator of the 9 Smithsonian archaeological projects whipped together in the fall of 1933, has written an introduction in which an essentially correct history of the Ocmulgee project is briefly narrated and credit is given to the many diverse persons and groups who participated in the recovery of the archaeological data and the establishment of a national monument at one of the most important sites in the Southeast.

In summary, this seems to me to be a good book, well organized and well presented. It seems to be based on conscientious analysis of the raw data and, in conjunction with other reports which continue to result from research in the Southeast, contributes its bit toward a clarification of the complex cultural history of the area.

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The Arzberger Site, Hughes County, South Dakota. Albert C. Spaulding. Occasional Contributions from the Museum of Anthropology of the University of Michigan, No. 16, Ann Arbor, 1956. 173 pp., 7 figs., 17 pls., 2 maps. $3.50.

In a stimulating and important contribution to archaeological knowledge of the central and northern Plains, Spaulding here reports on the 1939 excavations by a Columbia University-University of South Dakota Museum-WPA project in central South Dakota. Spaulding himself headed the Columbia field party under the general direction of W. D. Strong. In the years that have elapsed since the field work the interest of others concerned with the region has been constantly stimulated by preliminary statements and intriguing rumors of what was found at Arzberger. The present report generously rewards our long wait and also demonstrates the good judgment of those who selected the site for excavation.

The Arzberger site, situated about 7 miles east of Pierre, occupies a commanding location on a high terrace remnant more than 100 feet above the Missouri River. Included in the site complex were some 44 recognizable house depressions irregularly scattered over more than 40 acres and enclosed by a fortification ditch 1.5 miles long which had 24 bastions. The ditch was trenched and more than 325 feet of the stockade on its inner margin were stripped; 4 house sites were cleared; and 6 burials on a knoll outside the fortification, but not certainly identifiable with the site, were opened.

The excavations, the various features, and the artifacts are described in admirable clarity and detail. Circular houses, barely subsurface and with 4 single or multiple primary roof supports, immediately suggest a late prehistoric or "protohistoric" time level. This impression derives support from the presence of pottery and other elements that recall Oneota and Lower Loup traditions. The pottery complex itself is a curiously varied and interesting one. Present as surface treatment are grooved paddling (simple stamping), cord-wrapped paddling, smoothing, brushing, and red filming; rims include both uncollared and collared incised types. Much of this is reminiscent of prehistoric Central Plains complexes, particularly the Upper Republican aspect. No great depth of refuse or stratification was noted, and Spaulding demonstrates statistically that the complex is a homogeneous

one rather than a succession of distinct cultures. There were no White contact materials.

Analysis of the cultural affiliations and chronological position of Arzberger involves detailed comparisons with a variety of other sites and complexes to the north, east, and south. Much of this, unfortunately, as for the Central Plains, has to be done in the absence of detailed published reports on several comprehensive digs of major importance. Thus, it is a thorny and boulder-strewn trail that Spaulding must follow. He finds that Arzberger is basically of Central Plains Upper Republican type, with influences from Oneota and Middle Mandan traditions. He concludes that it is later than the nearby Monroe and Anderson foci, the Over focus of southeastern South Dakota, and St. Helena; and he suggests chronological equivalence, as well as probable cultural interchange, with the Huff fortified site in North Dakota. Not unexpectedly, he encounters chronological difficulties (for example, La Roche versus Huff and Thomas Riggs) in which treering dates and archaeological chronology are at variance. His final assignment of Arzberger to the late 15th century and a partial coexistence with an Oneota tradition seems reasonable. That it is an early Arikara manifestation is an interesting possibility.

That exception can and will be taken to many of Spaulding's interpretations and correlations is, of course, to be expected. As one example, I have some difficulty in seeing the "specific, detailed, and unmistakable similarity of many Arzberger vessels to illustrated Oneota specimens." I am also in some doubt as to the validity of attempting close comparisons between a series of presumed 15th century remains and such comparatively late Oneota manifestations as Orr and Blue Earth. Other readers will undoubtedly find additional debatable assertions. It should be borne in mind, of course, that Spaulding was threading his way through a difficult and complex period of Plains-Prairie prehistory during which there was evidently a great deal of movement of peoples and extensive interplay of diverse cultures along this section of the Missouri. Moreover, the area is one in which the crucially important time factor is not yet adequately controlled. His basic conclusions, however, will probably stand. Arzberger is essentially a late prehistoric northern outpost of Central Plains culture standing at a busy crossroads in both time and space. This, in turn, opens a series of interesting problems.

Strong pointed out long ago that Arzberger is the sort of combination of early and late elements that would provide a convenient link between the prehistoric Upper Republican aspect and the later Lower Loup-historic Pawnee sequence. Since no similar transitional stage has yet been found in Nebraska, it seems possible that the Central Plains were largely depopulated in late Upper Republican times with a shift of peoples to the Missouri, where the transformation into Arikara and Pawnee cultures took place. This basic idea has been in the thinking of Central Plains archaeologists for 15 years or more. Spaulding recognizes the possibility but he shows commendable restraint in suggesting (1) that Arzberger and the particular assemblage it represents may stand in an "avuncular" rather than paternal relationship to Lower Loup; and (2) that there is still much we need to know about the area south and east of Arzberger, in South Dakota as well as in northeastern Nebraska.

In settling on a 15th century dating for Arzberger, Spaulding clears the way for a more realistic approach than has been followed by some of his predecessors with respect to the presumed drought-induced population movements out of the Central Plains to the Missouri and then back to the Pawnee area. If this is actually what happened, the main exodus from the Nebraska plains must have well antedated the drought of 1539-64, for by this time the Pawnee were undoubtedly well established in the Platte-Loup drainage and their culture was of Lower Loup type, not that of the pre-White contact Upper Republican.

Spaulding has done an outstanding job of reporting a highly significant excavation project. Where he may have fallen short, it points up the extremely scanty nature of our available knowledge of the details of prehistory in the area. On the whole, I think Spaulding has contributed penetrating insights into some of the broader problems of Plains prehistory, as well as into Plains-Prairie relationships. Workers in and around the Plains, whether they agree or disagree with his views and interpretations, will certainly be referring to the Arzberger report for a long time to come. It is perhaps timely to voice also the hope that the reporting of some of the other archaeological projects conducted in the Plains with relief labor will fall into equally sympathetic and competent hands.

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Arqueología Indocubana. José Álvarez Conde. Publicaciones de la Junta Nacional de Arqueología y Etnología, Havana, 1956. 329 pp., 62 pls.

The classic studies of prehistoric Cuban archaeology by José Cosculluela (1922, *La Prehistoria de Cuba*), Fernando Ortiz (1922, *Historia de la Arqueología Cubana*; 1935, *Historia de la Arqueología Indocubana*), Harrington (1935, *Cuba antes de Colón*), and Herrera Fritot (1936, *Culturas Aborígenes de las Antillas*) have long been insufficient as general coverages of the field. A considerable number of important new data have been gathered in the ensuing years, with consequent reinterpretations. In approaching Álvarez' volume the reader should, therefore, remember that it is the first and only survey of prehistoric Cuban archaeology written for a Spanish public by a native Cuban archaeologist in many years. For this single reason the book is a noteworthy attempt to fill a too-long vacant gap, and it should be appraised in that light.

The author is by profession a teacher in the field of natural sciences at the Institute of Secondary Education in Santa Clara, Cuba. Archaeology, though apparently an abiding interest stemming from early days, is a second profession to him. We should not refer to Álvarez' interest as a hobby, for it is obviously more serious and meticu-

lous than that, but, in the academic sense we are used to in this country, the author is not a career archaeologist.

Bearing these 2 facts in mind it is both possible and mandatory to make a double evaluation of the book. The first evaluation, limited to professionals in the United States, is made solely to inform the potential reader of the contents and of the approach which Álvarez uses. The second evaluation — actually the only valid one in terms of the purpose for which the book was written — concerns the value of the volume to Cuban and Latin American readers, particularly the value to the man in the street.

The professional reader in this country will, frankly, not be impressed by Álvarez' treatment of his subject matter. He is overly brief, vague in his terminology, and presents neither a coherent temporal nor spatial picture of pre-Columbian Cuban cultures. Furthermore, his definition of specimens, particularly ceramic ones, is not as clear or as orderly as American professionals would desire. The excellently photographed and reproduced specimens from the Museo Montané of the University of Havana are not identified, in most instances, by style, cultural affiliation, provenience, or catalog number. Most quotations are not adequately documented for the interested reader, nor does the volume contain a bibliography. The archaeologist who is not conversant with the Antillean area will, it is true, get a brief bird's-eye view of prehistoric Cuba, but the picture will seem garbled. Finally, the terminology used to designate the archaeological cultures is not that normally used by American specialists in the field. This latter point will present little trouble to the area specialist, but it will simply add to the confusion of the archaeologist wishing to introduce himself to the region and then add further readings from English sources. The American professional should remember, however, that since the volume was not primarily written for his benefit, these crticisms have only partial validity.

Arqueologia Indocubana is intended for both professionals and the general reading public of Latin America, especially for a Cuban reading public. The Cuban professional will find that Álvarez' terminology coincides by and large with that locally in current use, though he, too, will probably object to the overly brief and none too concise presentation of the archaeological data. On the other hand the simplicity of the language, the profuseness of the illustrations, and the didactic appproach should prove both interesting and valuable to the general Cuban reader, for this aspect of Cuban history has been sadly neglected in popular published sources. In this latter sense the book is a most welcome addition to Antillean literature and serves an eminently utilitarian purpose, though it cannot replace the works of Cosculluela, Ortiz, Harrington, and Herrera Fritot.

In the first section (pp. 25-172) Álvarez gives a rather well-written summary of historical sources on Cuban archaeological cultures from the writings of Las Casas to the present, a brief list of museum and private collections in Cuba and abroad, and a detailed biographical listing of the important workers in Cuban archaeology present and past, native and foreign. This section will be of interest to most readers. The remainder of the volume (pp. 173-329) is devoted to chapters on the ethnography of the 3 major cultural groups and the varieties of artifacts typifying each group, wtih illustrations. It is this latter section that raised the adverse criticisms made earlier, and it is these chapters that will make the professional in this country use the volume with extreme caution as a reference or guide.

Specifically, Álvarez uses the classification of *Guanahatabey*, *Ciboney*, and *Taino* for the prehistoric Cuban cultures, usually corresponding to the terms *Ciboney*, *Sub-Taino*, and *Taino* respectively as used in recent literature in the United States. This confusing difference of terminology is unfortunate both in itself and in the fact that some sites which we would consider Ciboney (that is, Cuban *Guanahatabey*) are considered by Álvarez and others as Sub-Taino (that is, Cuban *Ciboney*). It would perhaps have been clearer for the American professional if the terms arrived at during the roundtable meeting of Caribbean archaeologists in Havana in September, 1950, had been used that is, *Cultural Complex I* (Shell), *Cultural Complex II* (Stone), and *Cultural Complex III* (Pottery). The author could then have let the reader know how he was placing the Guanahatabey, Ciboney, and Taino in reference to these 3 complexes. The relationship is not very clear in the volume and seems of basic importance to professionals as well as to the general public.

Regardless of these criticisms, Álvarez' work, treated carefully, is a welcome addition to the field. A blend of popularization and systematic study, it will be of value primarily to the Cuban public, where it is needed most.

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NOTES AND NEWS

EDITED BY CLEMENT W. MEIGHAN

GENERAL

One measure of the growth of scientific archaeology in the New World may be seen in the number of publications appearing each year. The very rapid expansion of archaeological reporting can be seen clearly in the increasing work of compiling "Some Recent Publications" which appears in this number. This annual compilation is made by the assistant editors who also prepare Notes and News; hence a brief history of "Some Recent Publications" is appropriate here. In Volume 1 of this journal, only 27 publications in American archaeology were reported (these, of course, are in addition to what appeared in AMERICAN ANTIQUITY itself). The number of annual publications remained small until 1942, when there was a considerable jump which persisted through World War II. Following the war, there was another big increase to the present level, which has listed more than 400 titles each year since 1948. This year's total of 695 titles is the all-time high.

These figures represent a better than 10-fold increase in archaeological titles in only 12 years, a remarkable record in view of the continuing small number of professional archaeologists in the New World. Considering that only a thousand or so scholars have been publishing their results at the rate of more than one paper a day for the past 10 years, perhaps the oft-heard lamentation about slow publication is not entirely justified. At least, archaeologists are probably as good at reporting their research as scholars in other disciplines.

Along with increase in publication has gone a corresponding difficulty in keeping up with the research results in one's field of interest. In the early volumes of this journal, the assistant editors could list all the publications for their region out of their heads. Today, these editors must devote considerable effort to maintaining a bibliography; even so, they occasionally miss articles of some significance. A few of the titles reported this time date back as far as 1953, and they are just now getting reported in our pages. Members of the S.A.A. can ensure prompt listing of their own research efforts by sending titles or reprints to their assistant editor. Since many papers are now published in local journals that may not come to the attention of the regional editors, such cooperation has become almost essential if our annual bibliography is to be complete.

ARCTIC

The following are delayed reports of 1956 fieldwork.

ALASKA. Gordon H. Marsh, of the University of Alaska, conducted 2 brief reconnaissance trips. The first was an investigation of a gravel spit at Alexandrovsk on English Bay, near the mouth of Cook Inlet, where the proposed building of an airstrip threatened to destroy a site. His survey revealed a row of rectangular house pits which appear to mark a relatively brief period of postcontact settlement. Possibly older portions of the site will not be disturbed by the airstrip, and may be returned to later. Marsh's other survey was carried out in the vicinity of Manley Hot Springs on the Lower Tanana River. A deposit of animal bones here, some of them representing an extinct form of bison, was test-pitted, but no signs of human occupation were detected.

John M. Campbell, of Yale University, discovered a new site on the west bank of Contact Creek, high up in Anaktuvuk Pass in the Brooks Range. The site area consisted of several concentrations of artifacts along a quarter-mile stretch of the creek, and unstratified material was recovered from the uppermost 12 inches of soil cover. A single hearth was the only unusual feature noted. The most characteristic artifact type is a large, lanceolate projectile point or blade, most examples of which have a convex base and show fine parallel, oblique flaking on one or both surfaces. Quite large end scrapers are also numerous in his collection. Aside from these, Campbell comments on the extraordinary number of large chert spalls found at the site. There was no trace at all of pottery, ground or polished stone, slate, microliths, or polyhedral cores. Thus far, the material in general does not seem to fit any of the complexes which have been described for the American Arctic.

SOUTHAMPTON ISLAND. From June through August of 1956, William E. Taylor, of the Canadian Museum of Human History, together with Charles H. McNutt, Museum of Anthropology, University of Michigan, worked at Native Point for the purpose of completing the program begun and directed there by Henry B. Collins during 1954 and 1955. The previous concentration had been on Dorset and proto-Dorset sites in the area, so the 1956 season was devoted primarily to the village site where the last of the Sadlermiut Eskimos died in 1903. In addition to the collection of artifacts and human skeletal material, a specific study was made of Sadlermiut architecture as exemplified in the 90 house ruins in the site. These are characterized by ground-level floors, storage alcoves which flank the entrance passage, as well as a uniquely massive construction of walls and interior storage compartments. Sadlermiut cultural origins are still a matter of question, but, most recently, Collins has suggested that here was initially a Dorset culture which was later overlaid by heavy Thule influences.

* * *

The following projects are on the Arctic docket for the summer of 1957:

John M. Campbell, supported by a grant from the Arctic Institute of North America, will return for 2 months of excavation and further reconnaissance at the Contact Creek site in Anaktuvuk Pass, Alaska.

T. H. Manning and A. H. Macpherson plan to be working on King William Island and Adelaide Peninsula for the Canadian Museum of Natural History. They will

be interested mainly in birds and mammals, but will also carry out exploratory archaeology as the occasion arises.

Jorgen Meldgaard, of the Danish National Museum, goes to Pond Inlet, northern Baffin Island, in July, and hopes also to revisit Igloolik, on Melville Peninsula, in order to supplement his 1954 operation there with new data.

William E. Taylor expects to investigate some house ruins that have been reported at Payne Lake in the interior of Ungava Peninsula. He will survey the immediate area, and if time permits he also plans to reconnoiter portions of the west coast of Ungava Bay.

Richard S. MacNeish, of the Canadian Museum of Human History, will be operating in the southern Yukon Territory, in the area between Whitehorse and Dawson. He will be assisted in the field by 2 Canadian students now attending the University of Michigan, Mark Molot and Reginald Hamel.

Assembled by ELMER HARP, JR.

WEST COAST AND GREAT BASIN

BRITISH COLUMBIA. Under the direction of Charles Borden, and supported by funds from the University of British Columbia Committee on Research, students of an anthropology class on British Columbia prehistory and members of the University Archaeology Club have been engaged since October, 1956, in excavating the accumulated house floor deposits inside one of the 2 remaining old houses of a recent Coast Salish village on the Musqueam Indian Reserve, Vancouver, B.C. The total depth of the deposit is more than 5½ feet, the uppermost 12 to 14 inches being within the historic horizon. The finds (more than 10 artifacts per cubic yard) are adding significantly to our knowledge of the late period in the Fraser Delta sequence.

WASHINGTON. Excavations in the Ice Harbor Reservoir on the lower Snake River are being conducted by Richard D. Daugherty of the State College of Washington under a grant from the National Park Service. The area is one of considerable interest from the standpoint of determining cultural relationships between the prehistoric inhabitants of the Columbia and Snake River valleys.

Douglas Osborne of the University of Washington announces that field work will continue in The Dalles Reservoir area until the flooding takes place. An agreement with the Oregon Archaeological Society will permit excavations to continue at the Wakemap Mound. A group of interested Portland and Vancouver people have developed a technique for taking casts of petroglyphs, and assisted by Robert Butler of the University of Washington, are taking impressions of the more spectacular petroglyphs before these are inundated by the rising waters. Students in physical anthropology, under the direction of Frederick Hulse, are studying the skeletal material from The Dalles excavations.

The Chinook tribe has requested that a student archaeologist be assigned to their area where they will support excavations.

The National Park Service reports that Public Utility District No. 2 of Grant County, Washington, will spend $40,000 over the next 3 years to support archaeological excavations in the Priest Rapids and Wanapum reservoir areas on the Columbia River.

With the assistance of students from Western Washington College of Education, Herbert C. Taylor, Jr. will conduct an archaeological survey of the upper Skagit, Ross Lake, and Lake Chelan areas of northern Washington late in August. Taylor and Angelo Anastasio are spending part of the summer in excavating a stratified midden, probably a Semiahmoo site, on the south coast of the Gulf of Georgia.

OREGON. Continuing work begun last summer, a field party from the University of Oregon is spending the summer excavating in the Tillamook area under the direction of Luther Cressman.

Cressman announces that the report on the excavations carried out in The Dalles Reservoir, on the Oregon side of the river, is being prepared for publication and should be ready for the press in the fall. Plans call for the publication of the results of the various field projects, carried on from 1952-56, in a single monograph rather than in a series of papers scattered through different journals. It is felt that this will give a more significant picture of the cultural developments in the area and facilitate use of the results by interested persons.

Under the direction of Roy L. Carlson, Curator, the Klamath County Museum plans to conduct excavations at a site on Lower Klamath Lake this summer.

CALIFORNIA. R. F. Heizer reports that the University of California Archaeological Survey has completed a short reconnaissance of an area in the foothills of the Northern Sierra Nevada. The purpose of the survey was to locate sites from which evidence of proto-Maidu occupation might be recovered, with the ultimate goal of determining, if possible, relationships between the prehistoric people of this area and those who occupied the Yana territory to the northwest. Several open sites and a series of dry-deposit rock shelters were recorded; enough archaeological material may be expected from the excavation of the latter to provide a firm foundation for comparison of the 2 regions. A report by M. A. Baumhoff, analyzing material recovered in 1956 from Payne's Cave, in Yana territory, is now in press. This report supplements findings made by Baumhoff from nearby Kingsley Cave, thus adding to our knowledge of foothill Yana and perhaps Maidu prehistory.

A survey of the Prosser Creek and Stampede Valley districts, north of Lake Tahoe in California, is planned for the late summer of 1957. Work will be done in cooperation with the National Park Service. The results of the survey will be integrated with information already obtained regarding the Martis complex of the region. Any sites recommended for excavation will be reported to the Park Service, in anticipation of proposed destruction or inundation by Federal dam projects. Several sites in the Trinity River power project region are scheduled for excavation by the University of California, Berkeley, in

cooperation with the National Park Service and San Francisco State College. The sites were surveyed by A. E. Treganza in 1952, in connection with the River Basin program of salvage archaeology.

A. B. Elsasser and E. Contreras have been engaged in a continuing project involving a resurvey of some of the more specticular petroglyphs of California. Pictographs of Tulare County have been chosen as those most in need of complete recording by color photography and scale drawings before the originals are destroyed or irreparably altered by vandals. J. Werlhof and J. Vierhus of the California School of Fine Arts, San Francisco, have been cooperating in the project.

M. A. Baumhoff, G. L. Grosscup, and R. J. Squier have been acting successively as E. H. Harriman Fund research assistants at the University of California, Berkeley. The purpose of the assistantships has been to put on record the unpublished ethnogeographic work of C. Hart Merriam, by means of organizing part of the Merriam collection of manuscripts, maps, and notes, and at the same time relating them to the work of other ethnographers or archaeologists in certain selected regions. Results have proved valuable in the clarification of problems concerning hitherto doubtful geographical borders and in providing stimulus for more exact location of recorded and unrecorded archaeological sites in California and Nevada.

Students of Sacramento State College have been engaged in salvage excavations in the Monticello Reservoir area west of Winters, California, under contract with the National Park Service through the Sacramento State College Foundation, with Richard Reeve, Brigham Arnold, and Norman Wilson in charge. Sacramento State College will include an archaeological field school in the High Sierras, north of Lake Tahoe, as part of the summer session curriculum.

A class of 15 students from the University of Southern California will carry on investigations of several sites at Cameo Cove near Laguna Beach. Some preliminary work was done here last summer by the University of Southern California. The sites are in a location soon to be developed for a housing subdivision.

Alice Hunt, collaborator with the Department of Anthropology, University of Southern California, has resumed her field work in Death Valley. Her work during last winter was mostly on gravel terraces overlooking Death Valley (sea level to 1500 feet altitude). Of greatest interest was her discovery of 2 (possibly 3) habitation sites with Lake Mohave type projectile points and accompanying tool assemblages. These represent the earliest authentic evidences of human occupation yet discovered in Death Valley.

John C. Tyler, formerly with the Museum of Anthropology, University of California at Berkeley, has joined the staff of the Department of Geology and Anthropology of the Santa Barbara Museum of Natural History as Preparator.

UTAH. James H. Gunnerson spent the winter months writing a report of his last 2 seasons of work in the Fremont area. His study includes extensive microscopic analysis of pottery carried on during the past 15 months.

The department at Utah is much encouraged by the growth of the Utah Statewide Archeological Society. This organization has published 2 volumes (of 4 numbers each) of a newsletter, *Utah Archeology*, in 1955 and 1956, at department expense. This support was withdrawn as of December 1956 and a membership charge initiated. Interest was sufficient that by March 1957 membership totaled more than 50. One local chapter at Moab has been organized, and it is hoped that continuing growth can be reported.

NATIONAL PARK SERVICE. Paul Schumacher, National Park Service Archeologist, resumed excavations at Fort Clatsop during the spring. Of particular importance was a more definite determination of the location of the Lewis and Clark fort used during the winter of 1805-06.

Flooding in the Monticello Reservoir, brought on by heavy winter rains, caused difficulty in salvaging the remaining archaeological sites. Sacramento State College and the National Park Service are cooperating in the excavation program which is under the direction of Richard N. Reeve of Sacramento State College. Working nearly every weekend during the winter and spring, 3 sites were excavated and 2 more were tested.

The Bishop Museum, under contract with Hawaii National Park, is doing an intensive study of the City of Refuge National Historic Park. The archaeological work is under the direction of Kenneth P. Emory. Botanical, ethnological, physical geographic, historical, and marine reef and shore fauna studies are being carried on in conjunction with the project.

Asembled by RICHARD D. DAUGHERTY

SOUTHWEST

ARIZONA. An announcement of the recent opening of the new University of Arizona Geochronology Laboratories is furnished by Terah L. Smiley. The laboratories are housed in buildings originally constructed and used by the Desert Laboratory of the Carnegie Institution of Washington. They have been made available to the University through the cooperation of the Rocky Mountain Range and Forest Experiment Station, U.S. Department of Agriculture. Financial assistance for the purchase of equipment was made possible through the Rockefeller Foundation. A new pollen analysis laboratory and a vertebrate paleontology laboratory are located in the buildings. A geochemistry laboratory and a radioactive dating laboratory are planned for the near future. An academic program in geochronology has been established within the Graduate College of the University. A Master of Science degree and a minor subject for doctoral candidates in related fields is now offered to qualified students. Interested persons may obtain information from the Director, Geochronology Laboratories, or the Graduate College, University of Arizona, Tucson.

William Wasley has prepared an 8-page description of "The Archaeological Survey of the Arizona State Mu-

seum." It contains a map with the survey grid for Arizona and adjacent areas superimposed, a reproduction of the site card form, an explanation of the method of site designation, and a description of the storage of survey collections. Copies are available for distribution to interested students and professionals from Wasley at the Arizona State Museum, Tucson.

Raymond H. Thompson is directing the University of Arizona's 12th annual archaeological field school at Point of Pines, San Carlos Indian Reservation.

Charles Di Peso reports that the Amerind Foundation has completed the excavation of the Reeve Ruin, near Redington, and that the report on this excavation is being prepared. Currently a field party, directed by Rex Gerald, has been able to define a western immigration into the San Pedro river valley which occurred during the Ootam Reassertion Period (A.D. 1300-1700). This intrusion is marked by a number of site units which extend as far south as Cascabel in the San Pedro drainage. Stone masonry, subterranean kivas, Gila-Tucson polychrome pottery tradition, a northern lithic complex, and a Pueblo-id settlement pattern are diagnostic of this particular intrusion, and indicate that it was definitely different from the culture of the indigenous people living in the valley at a comparable time period.

The Museum of Northern Arizona, Flagstaff, cooperating with the National Park Service, will excavate one or more pre-eruptive sites at Sunset Crater National Monument. Several pit houses will be roofed over and preserved as exhibits for the public.

Paul S. Martin and John Rinaldo, of the Chicago Museum of Natural History, expect to resume archaeological work in the area of the upper Little Colorado and between Showlow and Springerville. A new camp headquarters has been established at Vernon, Arizona.

Southwestern National Monuments headquarters at Globe, Arizona, is being changed from an administrative headquarters to a technical headquarters. Details regarding the reorganization are not available at this time, but it is likely that the archaeological preservation laboratory and at least a part of the stabilization unit will be located at Globe. The majority of the personnel stationed there will be moved to other areas in the National Park Service system.

This year's Pecos Conference is scheduled to be held at the National Park Service facilities at Globe, August 26-28.

New Mexico. Frank C. Hibben has selected 3 sites for the University of New Mexico field session this summer. A third season will be spent at Pottery Mound, near Los Lunas, New Mexico. The outstanding feature of this site is the discovery of 4 kivas with remarkably intact painted walls. Two of these kivas have been excavated, revealing a series of most interesting paintings. It will also be New Mexico's third season at the early man site near Lucy, New Mexico. The Lucy site contains Sandia, Clovis Fluted, Classic Folsom, Pinto, and possibly some other types of material. This season's excavations will concentrate on working out stratification and relationships of the various kinds of materials. Additional excavations in the Gallina area will be carried on at a site on the western periphery near Starve Out Ridge. With the completion of this excavation it is contemplated that the final report on the Gallina area will be possible.

Numerous activities are reported from Santa Fe. Bertha Dutton and Agnes Sims, of the Museum of New Mexico, are working on a projected publication of the Kuaua (Am. Antiq. Vol. 13, No. 3, pp. 218-23, 1948) murals, with view to reproducing the layers of painting along with text figures and brief notes. The Senior Girl Scout archaeological mobile camps will be directed for the 11th year by Bertha Dutton. Stewart Peckham and Edward Dittert, of the Museum of New Mexico's Department of Highway Salvage Archaeology, have excavated 6 sites on various highway construction projects. These include a small Tularosa phase site near Reserve; a portion of a historic Zuni site near Ramah; a White Mound phase pit house 20 miles west of Albuquerque, and 3 sites near the Ambrosia Lake uranium fields northwest of Grants. The latter 3 sites represent a cultural sequence ranging from about A.D. 850 to 1100, and contained both pithouses and surface masonry walled structures.

Texas Technological College, Lubbock, is planning a longrange project of historical and archaeological research near Taos, New Mexico. Fred Wendorf will be its director. This summer the primary efforts will be in excavating a pre-Civil War U.S. Army post located 10 miles south of Taos at Pot Creek. Restoration of the fort is contemplated so that it will serve as a field school headquarters in future years, and eventually become a museum.

Colorado. Joe Ben Wheat, of the University of Colorado Museum, will continue excavations at the Yellow Jacket site in southwestern Colorado. The University of Colorado's radioactive dating laboratory has developed to the point of running samples for calibration purposes.

Northern Mexico. Richard Brooks, of the University of California, has recorded over 1500 archaeological sites in south central Chihuahua and northern Durango, Mexico, and plans to continue his survey until the middle of the summer. When completed, this research should add to our ideas of Southwestern-Mexican connections in north central Mexico.

Upper Colorado River Project. Several institutions will assist in salvage archaeology projects in connection with the Upper Colorado River reclamation program. The National Park Service has contracts with the Museum of Northern Arizona and the Museum of New Mexico, and a contract is pending with the University of Utah. The Museum of Northern Arizona will survey the main Glen Canyon. Gene Foster will complete this summer the survey of Glen Canyon she began 2 years ago. William C. Miller, an associate of the museum, and David Breternitz, Curator of Anthropology, will work that portion of Navajo Canyon which is to be flooded by waters impounded behind the Glen Canyon dam. In the late summer the museum plans to have a party in the lower San Juan, which also will be flooded by the Glen Canyon

lake. The Museum of New Mexico has started a survey of the construction area of the Navajo Dam on the San Juan River north of Blanco, New Mexico. The University of Utah has carried out preliminary negotiations for a contract to recover data from the Glen Canyon-Flaming Gorge reservoirs.

Assembled by ROBERT H. LISTER

PLAINS

ALBERTA. At the Glenbow Foundation in Calgary, Jack D. Herbert has been appointed Executive Director succeeding Douglas Leechman who has retired. The Glenbow Headquarters at Hull House is being made over to provide adequate facilities for historical, archaeological, and related research. Richard G. Forbis joined the staff as Archaeologist on May 1 and will spend the year examining collections, surveying sites, and in general continuing on a full-time basis the work done under Glenbow auspices during the past 2 summers by Wormington, Mulloy, and Davis.

SASKATCHEWAN. Archaeological activity is increasing in Saskatchewan. The first major report on an excavation in the province, Wettlaufer's report on the Mortlach site, appeared recently. R. W. Nero, Assistant Director of the Saskatchewan Museum of Natural History in Regina (a part of the Conservation Branch of the Department of Natural Resources), reports that the museum plans to increase its archaeological program. Storage facilities and a study room for archaeology and ethnology are currently being set up. In the summer of 1957 a survey will be made along a 15-mile stretch of the valley of Long Creek in southeastern Saskatchewan, which will be flooded following the erection of a dam in the summer of 1958. If a significant site is found, excavation is planned. Meanwhile, examination and recording of sites as a general activity is being increased. The museum expects shortly to publish the results of a small test excavation made in 1956 in a hearth site 11 feet deep in a river bank in southeastern Saskatchewan.

NORTH DAKOTA. At the State Historical Society in Bismarck a report on the 1954 excavations at Kipp's Post, a trading post occupied about 1826-30, is expected to be published this year. Also soon to appear is the report on the 1955 work at the Paul Brave site, 32SI4, an "Archaic Mandan" site similar to the Thomas Riggs site in central South Dakota, but different enough to preclude assignment to the same focus. The report on the 1956 work at the Demery site, 39CO1, is in preparation. This is the northernmost site known to have straight-rimmed pottery with horizontally incised rims ("Category B"), and it differs from similar sites farther south in certain important respects. The 4 houses excavated at Demery are circular and have 4 center posts, but a total absence of wall postholes implies a method of roofing the housees quite different from that used in the circular earth lodges of the historic Arikara and Mandan. Ceramics indicate relationships with sites of the La Roche and other South Dakota complexes, as well as showing some local derivation from "Archaic Mandan." There are no trade goods, and the site is estimated to date from about A.D. 1550 to 1650.

W. Raymond Wood left the Historical Society staff in March to take a position with the University of Missouri, and Alan R. Woolworth is planning to leave about May 1. Accordingly, plans for future field work by the Historical Society are indefinite.

SOUTH DAKOTA. The big effort on the plains, this year as in past years, is on the mainstem of the Missouri, where the Oahe Reservoir area and, immediately downstream, the Big Bend Reservoir area constitute the only section of the Middle Missouri where there is still time for salvage work. In Oahe, 4 field parties from the Lincoln office of the Smithsonian Institution-River Basin Surveys will be at work. Waldo R. Wedel will excavate at the Black Widow site near the Fort Bennet area in Stanley County, and will test nearby sites. Robert L. Stephenson will put in a second season at the Sully site in Sully County. Two other parties will be testing and mapping sites on both sides of the river in the Oahe area. Also in Oahe will be a field party sponsored jointly by the University of South Dakota Museum, the South Dakota Archeological Commission, and the National Park Service. This party, under Wesley R. Hurt, will work at the Rosa site in Potter County, a large historic site with many metal artifacts. It may be one of the villages visited by Lewis and Clark above the Arikara village at the mouth of the Cheyenne.

In the Big Bend Reservoir, the Smithsonian expects to have 4 field parties at work. G. Hubert Smith will carry on test excavations south of Pierre at the historic sites of Fort George and Fort Bouis-Defiance as well as at 39-HU15, an unusual historic site of unknown affiliation. Warren W. Caldwell will be working at a village site and burial mound on the west bank near Fort Thompson. Robert W. Neuman will be working in 3 La Roche-like sites on the east bank near Fort Thompson. Harold Huscher is expected to be test-excavating and mapping about 14 different sites between Fort Thompson and the Big Bend.

Oldemar Blasi, Professor of Geography and History, Colégio Estadual, Curitiba, Paraná, Brazil, has received a grant from the State Department to study Plains archaeology for 8 months at the University of South Dakota Museum.

WYOMING. David Gebhard of the Roswell, New Mexico, Museum will again take a field party into western and southwestern Wyoming, under the sponsorship of the Museum and the Western Foundation, Inc. Work at Torrey Lake in the upper Wind River Valley will be continued, and a survey will be made of the Sweetwater Rocks and Rattlesnake Mountain. The latter survey will be looking for evidences of the extension of Northwestern Plains Middle horizon cultures into the more southern areas of the state.

KANSAS. During May and June a Smithsonian Institution-River Basin Surveys field party worked in the Tor-

onto Reservoir area of southeastern Kansas, following preliminary work last fall by Alfred Johnson.

Roscoe Wilmeth, formerly at the University of South Dakota Museum, joined the staff of the Kansas State Historical Society as Assistant Museum Director at the end of January. He reports that the Museum, while primarily oriented toward history, hopes to get an archaeological program launched before long.

OKLAHOMA. Robert E. Bell reports that this summer he will be taking out the eighth summer field session in archaeology for the University of Oklahoma. Plans are not complete at this writing, but the field school will be doing salvage work probably in the Oolagah and/or Keystone Reservoir areas, both of which are relatively unknown archaeologically. James B. Shaeffer, Director of the Oklahoma Archaeological Salvage Project, has surveyed a number of highway projects, and in early March was occupied with salvage operations near Muskogee.

TEXAS. The main field work of the University of Texas is currently in the Caddoan area of East Texas, part of the Southeast rather than the Plains. However, the University's summer field course in archaeology will be working in central Texas, in and around Austin, under E. Mott Davis, and reservoir survey work in central Texas is also being contemplated.

Assembled by E. MOTT DAVIS

NORTHERN MISSISSIPPI VALLEY

ILLINOIS. Encouraging progress is reported by the Illinois Archaeological Survey; Elaine Bluhm has been compiling and coordinating site data, with the cooperation of many institutions and individuals. The Survey is housed at the University of Illinois, and both the Illinois State Museum and Southern Illinois University are collaborating on the project. The Highway Salvage Program sponsored by the Survey is rapidly developing to a point of critical urgency. The state plans to spend more than 200 million dollars on construction this year, some of which goes through known site areas. The highway department is cooperating fully and excavation will soon begin, as far as funds permit.

For the first summer in several years the University of Illinois will not have a summer dig, but plans are already being made for work in the Southwest next summer in cooperation with the Museum of Northern Arizona.

The Midwestern Archaeological Conference held last fall at Urbana was so successful that a second conference is to be held next fall at Beloit. A report of the fall meeting, a brief outline of one of the discussions involving general culture stages in this area, and an announcement of the next meeting have been distributed.

MISSOURI. The salvage program in the Table Rock Reservoir area is being continued this season, the final opportunity for work in this area since the dam is nearing completion and the water will begin to rise this fall. Two field parties are now working in the area, one under the direction of Carl H. Chapman, the other of Richard A. Marshall.

A new dam, to be built on the Pomme de Terre River, will require the transfer of the salvage operations to this new reservoir area. As a preliminary step, W. Raymond Wood, recently added to the staff of the University of Missouri as an Associate in Archaeological Research, has begun a survey of the area. When the Table Rock salvage is completed he will be joined by a field crew for excavation and additional testing of the most significant sites.

In the fall, when the work in the Table Rock area has been completed, Marshall will concentrate on the archaeological survey of areas slated for highway construction. This is part of the over-all program of highway salvage being initiated by the University of Missouri in cooperation with the Missouri Highway Department.

J. Mett Shippee conducted an archaeological survey of Laclede County in south central Missouri and resumed excavation of Research Cave in Callaway County. Charcoal samples from this site, now being analyzed by the Radiocarbon Laboratory at the University of Michigan, should be of considerable value in correlating the site with Graham Cave.

The Eleventh Field Session in Midwestern Archaeology at the University of Missouri will again be held in Ste. Genevieve County, on the Mississippi River about 65 miles south of St. Louis. Several salt pan sites will be excavated in addition to extensive testing of Mississippi and Woodland village sites in the area.

INDIANA. From June 17 to August 10 Indiana University will conduct its Archaeological Field School, under the direction of Glenn A. Black. As in the past, excavation and study will be carried on at the Angel Mounds site, with support from the Indiana Historical Society.

Assembled by MELVIN L. FOWLER

NORTHEAST

DELAWARE. George E. Jackson, Corresponding Secretary of the Archaeological Society of Delaware, reports that, "On March 13, 1955, under the sponsorship of the Delaware Archaeological Board, the Archaeological Association and the Archaeological Society of Delaware met to discuss a site survey of a statewide scope. With the rapid development of industrial and housing projects in Delaware, it is felt that it is important that these sites be mapped and described for future reference without delay." The Society is to conduct a survey of New Castle County and part of Kent County. The Sussex Association will cover the remainder of Kent County and all of Sussex County. The Sussex Association has virtually completed their portion of the survey. Completed reports of these surveys will be sent to the state archives.

NEW JERSEY. The New Jersey State Museum planned to recheck the sites of the Delaware River drainage area in June, bringing data up to date for the flood control work. Ronald J. Mason will direct this work.

NEW YORK. The New York State Museum and Science Service will inaugurate an intensive 2 or 3 year study of the development of aboriginal settlement patterns and their socio-economic correlates in the Northeast during 1957. Work was to begin on July 1 on an early prehistoric Mohawk Iroquois village site in the middle Mohawk Valley, with a party of seven under the direction of William A. Ritchie, who has received an $8800 grant-in-aid for this project from the National Science Foundation.

Alfred K. Guthe and Marian E. White will continue the Rochester Museum's investigation of the Morrow site, near Honeoye, New York. This multicomponent site, to be destroyed by a building development, has already yielded information regarding a Point Peninsula 2 (Middle Woodland I) cemetery. The nature of the Late Woodland and Historic components will be explored this summer with the aid of the Lewis H. Morgan Chapter of the New York State Archaeological Association.

In the Greater New York City area, Julius Lopez reports that the third season's work on the Pelham Boulder site, Bronx County, is underway. The 1957 program also includes the photographing and study of museum materials from the coast and collections presently on loan from Harry Trowbridge and George Younkheere (Schurz site material), Roy Latham (Ryder's Pond site, Kings County) and Ralph Solecki's collections including key component materials of the North Beach and Clearview foci, Windsor aspect. Participating in these activities will be Stanley Wisniewski, Timothy O'Leary, Julius Kiosi, Edward Kaeser, and Leonard Cohan. The need for such correlative efforts is becoming increasingly apparent in New York State and vicinity due to the quantity of materials already above the ground but not always known by all workers in the field.

PENNSYLVANIA. During February, 1957, several members of the Lower Susquehanna Chapter of the Society for Pennsylvania Archaeology and W. Fred Kinsey, Pennsylvania State Museum, excavated the Harry Heck Rock Shelter in Adams County. Flint tempered, interior and exterior cord-marked pottery and other materials indicate that the major occupation of this shelter was during the Early Woodland or incipient Middle Woodland period. During the summer, Kinsey plans to spend most of his time surveying and testing on the Lower Susquehanna River islands. Meanwhile, the Lower Susquehanna Chapter plans to uncover the floor plan of a second longhouse at the Leibhardt site in York County.

A Carnegie Museum, Pittsburgh, field party under the direction of Don W. Dragoo will conduct a survey and excavation program in the Beaver Valley of western Pennsylvania during the summer of 1957, concentrating on several early Archaic sites located along the shores of old glacial lakes. Two of these sites have also produced materials of the paleo-Indian period.

ONTARIO. The 1956 season was one of considerable activity by the Royal Ontario Museum, the University of Toronto, the National Museum of Canada, the University of Western Ontario, and members of the Ontario Archaeological Society.

The Royal Ontario Museum continued to supervise the excavation of the Serpent Mounds on the north shore of Rice Lake near Peterborough, Ontario, during 1956. Several hundred square feet of earth were excavated near the eastern end of "The Serpent." Kenneth E. Kidd states that, "It is as yet much too soon to decide upon the cultural attribution of the site. There are indications that the mounds are Hopewellian, . . . but they may be attributable to a similar but hitherto unknown manifestation." Work on this site will be continued during the 1957 season.

The Royal Ontario Museum will also have a party, under James V. Wright, excavating a site in Bruce County during 1957. The site is located in a newly established Provincial Park and is believed to contain Laurentian (Late Archaic), Point Peninsula (Middle Woodland), and early Iroquois material.

Walter A. Kenyon, of the Royal Ontario Museum, reports that 2 Iroquoian ossuaries judged to date from around 1250 were investigated on Tabor's Hill last year. This hill is a short distance east of Toronto in the township of Scarborough, Ontario. The first ossuary was encountered in August, 1956, by a steam shovel removing dirt from the hill. The larger of the two was 13.5 feet in diameter and 30 inches in depth; the smaller was 9 feet in diameter and 18 inches in depth. An estimated 472 individuals were represented by the skeletal remains. According to Kenyon, "Distribution of the bones showed that not cadavers, but disarticulated skeletons had been interred. Most of these were thrown in randomly, with no attempt to keep the bones of one particular individual together. Scattered throughout this maze of bone, however, was the occasional bundle burial; and 2 or 3 small pockets of burned bone suggest that cremation was also practiced. In a few of the skulls, the nasal passages and sinuses were packed with sand — evidence of an earlier burial, prior to their final interment in the heavy clay of Tabor's Hill." Additional work on these is planned by the Royal Ontario Museum.

A village site, believed to have been associated with these ossuaries, was excavated in October, 1956, by University of Toronto students under J. Norman Emerson's direction. Emerson reports, "the excavation of this site helps make clearer the pattern of prehistoric Iroquois development in Ontario. It would appear that early development began in southwestern Ontario in the area of London and St. Thomas and spread eastward about A.D. 1100. Some of these people stayed to become the Neutral tribe of the historic 1600's. Others apparently moved to the Metropolitan Toronto area and developed a pattern of migrating up the major river valley such as the Humber, the Don, Highland Creek, and the Rouge. As the centuries passed and villages were gradually moved northward these people became the Hurons of the historic 1600's. Thus the village of Scarborough may be described as either 'proto-Neutral' or perhaps 'proto-Huron.' It appears to have existed at a time when Iroquois tribalism may not as yet have come into being." Evidence of structures was sought, but no longhouse remains were observed.

In addition to the work on the village site in Scarborough, Emerson directed the excavation of the Ault Park site, on Sheek Island along the St. Lawrence Seaway. This is a Point Peninsula site which has been jointly excavated by the National Museum of Canada and the University of Toronto. The burials were cremations accompanied by grave offerings of blades, copper, and dogs. Occupational refuse has been recovered from other areas of the site and postmolds provide information on house structures of the Middle Woodland period. Emerson says, "It is still an open problem as to whether these remains represent long term occupation or whether they are just the periodic accumulation which accompanied visits to the Long Sault for burial rites." 1957 will see additional work accomplished at this site.

Thomas E. Lee, National Museum of Canada, carried out several projects during the 1956 field season. These included examination of sites east of the Saguenay River, a survey up the Saguenay and around Lake St. John, investigations near Montreal and extensive work in the Ottawa Valley. However, his major work was the examination of a large earthwork near Sarnia, Ontario. In 1950, Lee had tested the site and determined that it was not the historic mission of St. Francis and that Neutrals did not build it. The oval earthwork encloses an area extending along a low ridge. This ridge separates the beginnings of 2 stream beds. A section of one of these is enclosed by the earthwork. It appears that the fort was abandoned before completion. Cultural material is scarce, but a study of the pottery indicates that the predominant types can be associated with the Iroquoian materials of the Whittlesey Focus of Ohio. Some connection is also indicated with the Lalonde Focus and Neutral material from the prehistoric Lawson Site near London, Ontario. Lee also reports, "Several hundreds of well-preserved Indian cornhills were found and charted within the earthwork. These cover the entire enclosure and were in use after the fort was otherwise abandoned. They do not exceed 6 inches in height, are about 30 inches in diameter, are spaced roughly on 5-foot centers, and tend to lie in rows which may curve or wander irregularly."

Wilfrid Jury, University of Western Ontario, conducted excavations at the Forget Site near Midland, Ontario. This is a palisaded, prehistoric village. He also examined the Jesuit Mission site of Kahnawake located on the south side of the St. Lawrence River opposite Montreal. This was occupied between 1696 and 1719 and is on land soon to disappear with the development of the St. Lawrence Seaway Project. It was possible for him to trace the foundations of a church, the Jesuit residence, and several smaller homes. Parts of a palisade were also discovered. The work on this site was sponsored by the Jesuits of Lower Canada.

A small site of Point Peninsula occupation (the NRU Site) was investigated by Clyde Kennedy with the assistance of Thomas E. Lee during 1956. This is located along the Ottawa River about 5 miles east of the town of Chalk River. It is on the property of Atomic Energy of Canada Limited. Pottery types found here have been identified as: Vinette Complex Dentate, St. Lawrence Pseudo-Scallop Shell, Point Peninsula Corded, and Point Peninsula Rocker-Stamped. Additional material includes chipped flint, steatite, and bone objects.

Pottery in stratified layers has been located by Frank Ridley near the mouth of the Michipicoten River, north of Lake Superior. This work was accomplished with the assistance of the Archaeological and Historic Sites Board of Canada. Ridley reports that the pottery represents wares of Southern Ontario, Pennsylvania, and the Western Plains. This site may be of considerable significance in terms of cultural movements.

The Ontario Archaeological Society continued to work on the Robb Site in the Rouge River area near Markham, Ontario. This is a prehistoric Iroquoian village site which may yield information on settlement patterns. This group also located 20 sites in the Rouge River drainage basin through the continuation of the site survey project.

Assembled by ALFRED K. GUTH

SOUTHEAST

FLORIDA. The annual meeting of the Florida Anthropological Society was held at Rollins College February 1. The program included a number of contributed papers and a symposium on anthropological research in Florida, moderated by Charles Fairbanks. Participants included J. M. Goggin, Julian Granberry, William Sturtevant, and Irving Rouse.

Florida State University field school was excavating at the San Luis Mission site in the spring. Investigations were centered on the fortifications and the main gate, from which the main lock bolt has been found.

GEORGIA. Joseph Caldwell, for the Georgia Historical Commission and River Basin Surveys, has been excavating the mound at the historic Cherokee site of Tugalo. A number of construction stages have been defined, ranging in time from Etowah III to historic Cherokee periods. A nearby buried midden deposit dates back to Swift Creek times. One of the later stages of mound building was a log-covered flat-topped mound with a structure on its summit.

VIRGINIA. John L. Cotter reports that the Jamestown 350th Anniversary celebrbation opened at Colonial National Historical Park April 1. Both Jamestown and Yorktown now constitute demonstrations of how archaeological techniques can be employed to produce otherwise unrecorded and unobtainable data from historic sites. At Jamestown half a million objects representing almost all phases of daily life and activities, commodities, industries, and foreign imports, are now available for study. Data on 141 structures have been summarized. At Yorktown, reports on the discoveries of the key Redoubt No. 10 and various features investigated since 1934 are available to students of the Revolutionary period. A series of pamphlet studies on both areas and special articles in professional journals is appearing in 1957.

TEXAS. In the Caddoan area of northeastern Texas, a University of Texas field party directed by E. Mott Davis, cooperating with the National Park Service, carried on

10 weeks of salvage archaeology starting in January. Work this spring was devoted to the area of the minimum pool in the Ferrels Bridge Reservoir, centering on the Whelan site, a Fulton aspect site with pottery most closely resembling that of the Titus and Frankston foci. Four mounds and a part of the village area were investigated.

WASHINGTON, D.C. Archaeology with indoor plumbing was numbered among the delights of our nation's capitol this past winter. Limited excavations were made at the Old Stone House in the Old Georgetown area. This is the oldest surviving building in the district, built in 1766, and it is being restored by the National Park Service. Working with the architects, G. Hubert Smith cleared and excavated 2 ground floor rooms, a kitchen, and another room used as a shop. Among the additions to knowledge of the physical history of the building was the discovery, beneath the modern floor, of a small brick oven or industrial furnace. Artifacts obtained illustrate many aspects of building use, both industrial and commercial. Among the artifacts was some printer's type, evidence for a use of the structure not previously known despite exhaustive study of documentary sources on the building.

Assembled by W. H. SEARS

LOWLAND SOUTH AMERICA

BRAZIL. Peter Paul Hilbert of the Museu Paraense "Emilio Goeldi" continues his archaeological investigations in the middle Amazon region. In the fall of 1956, he visited Itacoatiara and made 2 stratigraphic excavations in habitation refuse that produced large quantities of sherds. Decoration included fine incision, zoomorphic and anthropomorphic appliqué, red on white painting, and broad line incision. Analysis of these strata cuts should give some indication of the temporal relationships between the various decorative techniques. Hilbert also visited the cemetery site at Miracanguera, first described at the end of the 19th century by Barbosa Rodrigues. He reports that the annual erosion by the river during the rainy season has almost completely washed the site away.

ECUADOR. During November and December of 1956, Betty J. Meggers and Clifford Evans, both of the Division of Archeology, U.S. National Museum, conducted survey and excavations on the Rio Napo, in the eastern lowlands of Ecuador. This area was selected because of the possibility that it might shed some light on the origins of the Marajoara mound culture, which is intrusive on Marajó Island at the mouth of the Amazon. Comparative analysis of the distribution of Marajoara traits suggested the strongest affiliations were with the northwestern part of South America and the Rio Napo seemed by its size and location to be a potential route of movement. The region surveyed was between the headwaters and the junction of the Rio Aguarico at the present Eucador-Peru border. Extensive habitation sites were found along the river banks where the elevation was sufficient to remain above flood level in the rainy season, but the sherd refuse deposits were very shallow indicating a brief period of habitation. The pottery complex includes a number of decorative techniques also characteristic of early Marajoara ceramics: excision on plain and red slipped surfaces, white paint in excisions, incision on white slip with red retouch, red on white and polychrome (black and red on white) painting. Vessel shapes and excised design motifs also resemble early Marajoara styles. Certain distinctive Marajoara traits such as tangas are absent in the Rio Napo complex, but in view of the distance separating the 2 areas, discrepancies are to be expected. The Rio Napo was not the place of origin of the Marajoara culture, however. The sites indicate that a large group of people with well-developed ceramics moved into the area, remained a short time and then left. Except for this large influx, the area appears to have been only sporadically inhabited by pottery making cultures.

PERU. The American Museum of Natural History has made a preliminary announcement of the results of the first systematic archaeological excavations in the Montaña area of Peru, carried out for the museum under direction of the late Harry Tschopik by Donlad Lathrap of Harvard University. Most of his excavations were in the Shipibo village of Yarinacocha on the Ucayali River, a major tributary of the Amazon. Here he discovered pottery and occupational debris indicating that the area had a long history and widespread connections with other parts of South America. Ceramic similarities with Formative cultures to the west and north occur at the bottom of the stratigraphic sequence, followed by indications of possible relationships with the culture of the Marajó region and with Venezuela and the Caribbean. Modern Shipibo pottery, occurring at the top of the deposit, appears to be quite recent in date.

Assembled by BETTY J. MEGGERS

HIGHLAND SOUTH AMERICA

CHILE. The Departamento de Extensión Cultural of the University of Santiago de Chile last year invited Oswald Menghin, of the University of Buenos Aires, for a series of lectures and excavations. One of the excavations made during his stay was of a cave floor in the region of Concepción, which yielded evidence of successive occupation by Araucanian groups, of which 3 horizons were recognized — 2 prehistoric and one historic. Upon invitation by local archaeological societies, Menghin also visited the museums of Angol and La Serena, as well as several archaeological sites in that vicinity.

The Museo Arqueológico of La Serena conducted a detailed survey of the Copiapó Valley in its entire extension from the highlands to the littoral. On the coast itself, several sites near Guanaqueros and Cruz Grande were excavated, and in the neighboring district of Ovalle the sites of Tuquí and Punitaqui were explored.

COLOMBIA. Julio César Cubillos of the University of Popayán supervised a group of students of the Instituto Colombiano de Antropología during the excavation of a recently discovered site at Bosa, near Bogotá. Several

test trenches revealed a shallow deposit of pottery fragments of late Chibcha style.

In January, Gerardo and Alicia Reichel-Dolmatoff of the Instituto Colombiano de Antropología conducted excavations on the upper Sinú River, where many sites were located near Tierra Alta and Tucurá. Several cuts in house middens yielded a large amount of pottery fragments and lithic artifacts, some of which seem to carry on a Late Formative tradition. During the month of February they surveyed the hitherto unexplored San Jorge drainage, east of the Sinú. Near Ayapél a Formative period site closely related to Momil was discovered. In the swampy region between Ayapél and San Marcos more than a hundred house-platform mounds were located, bordering the lagoons and channels for miles. Although the mound structure and the associated gold work show close parallels with the Betancí complex of the Sinú area, the pottery of the San Jorge mounds seems to represent a different tradition.

Ecuador. Fieldwork continued early this year in the coastal area of Guayaquil where Clifford Evans and Betty J. Meggers of the U.S. National Museum, in collaboration with Emilio Estrada, made several additional cuts at the Valdivia site. Nearby, several new sites of Bushnell's Guangala culture were discovered, and toward the southern coast a number of sites of the Manefio culture were excavated.

The first Mesa Redonda on Ecuadorian archaeology was held on February 7th in the conference rooms of the Casa de la Cultura Ecuatoriana, Núcleo del Guayas, in Guayaquil. The conference was organized by Carlos Zevallos Menéndez, president of this branch of the Casa de la Cultura. The following prepared papers were delivered in the morning session:

Pedro Armillas, archaeologist on a UNESCO mission to preserve and protect the archaeological monuments of Ecuador, spoke on the broad theoretical problems of interrelationships between Mesoamerica and Andean South America in terms of waves of diffusion, migration, and local specializations after an initial common relationship.

Francisco Huerta Rendón, University of Guayaquil, gave an illustrated talk on pottery neckrests from Ecuador. These are restricted to the Ecuadorian coastal provinces with some 14 examples now known. They were apparently used for sleeping to protect elaborate hair arrangements which are so well shown on the modeled figurines.

Olaf Holm discussed the problem of identification of the game Atahualpa played with the Spaniards, and concluded that it was an aboriginal game, rather than chess as has been suggested.

Clifford Evans, Division of Archeology, U.S. National Museum, spoke on the Formative periods of Chorrera and Tejar in the Guayas Province of Ecuador, showing the various traits in these 2 Ecuadorian periods that are common to the Formative horizons of Mesoamerica and Peru, and suggesting a north-to-south movement of this early culture.

Emilio Estrada, Museo Arquelógica "Victor Emilio Estrada," discussed the later periods, called Quevedo and Milagro, characterized by local Ecuadorian ceramic styles, metallurgy, and artificial mounds, and the earliest ceramic culture, the Valdivia, which is closely affiliated to Tlatilco in Mexico and the Guañape Period in Peru.

Betty J. Meggers, U.S. National Museum, presented evidence from recent field work that pottery of the Napo River has many resemblances to that of the Marajoara at the mouth of the Amazon, indicating that the Marajoara culture has its antecedents in the northwest part of South America.

Carlos Zevallos Menéndez, president of the Casa de la Cultura Ecuatoriana, Núcleo del Guayas, presented a paper on the possibility of marine navigation with balsa rafts and other aboriginal boats between Mesoamerica and Ecuador indicating that such craft might have been used not only as a means of migration, but also for establishing aboriginal trade routes.

Matthew W. Stirling, Bureau of American Ethnology, commented on the importance of a better knowledge of Ecuadorian archaeology for the clarification or solution of many problems of North West South American cultural origins and relationships.

The afternoon session was devoted to discussions and clarification of various points mentioned in the morning, and a summary of the interrelationships between Mesoamerica and South America during the Formative period.

Peru. Frédéric Engel, assisted by Edward Lanning of the University of California, reports the discovery of a new group of some 10 preceramic and premaize sites at Río Seco on the Central Coast, 87 km. north of Lima. Subterranean architecture and artificial mounds characterize these sites, as well as large quantities of twined textiles. Bone and wood implements were found, but stone artifacts were rare, except for one basalt point of a hitherto unknown type. Edward Lanning located a preceramic cemetery on the north flank of the Asia River, 102 km. south of Lima. Ten burials associated with twined and decorated textiles, many wood and bone artifacts, and 2 stone mortars were found. This is the second preceramic cemetery discovered by Engel and his associates in the coastal area, the first being near Huarmey, on the North Coast.

Fossil remains of Late Pleistocene fauna were discovered recently in the coastal ranges between Pisco and Ica, in the lower Ica and Nazca Valleys. Dr. Vellard, of the Institut Français d'Etudes Andines, is at present studying these finds, and has been able to bring one complete mastodon skeleton to Lima. No association with human remains or artifacts has been observed so far.

Assembled by G. Reichel-Dolmatoff

SOME RECENT PUBLICATIONS

This annual feature is contributed by the various Assistant Editors for their respective regions; it is assembled and edited by the Associate Editor for Notes and News. Titles on the Caribbean region were contributed by Irving B. Rouse. Omissions of recent titles should be called to the attention of the regional Assistant Editors so that they may be cited in next year's list. Articles appearing in AMERICAN ANTIQUITY are not included.

The following abbreviations are used in the references:

AA	*American Anthropologist*, n.s. Menasha.
AMNH-AP	*American Museum of Natural History, Anthropological Papers*. New York.
Ar	*Archaeology*. Cambridge, Massachusetts.
ASV-QB	*Archeological Society of Virginia, Quarterly Bulletin*. Staunton.
BAE-B	*Bureau of American Ethnology, Bulletin*. Washington.
CA	*Cuadernos Americanos*. Mexico.
CIAM-B	*Centro de Investigaciones Antropológicas de Mexico, Boletín*. Mexico.
CIW-CAAH	*Carnegie Institution of Washington, Contributions to American Anthropology and History*. Washington.
CIW-CR	*Carnegie Institution of Washington, Department of Archaeology, Current Reports*. Cambridge.
CIW-NMAAE	*Carnegie Institution of Washington, Notes on Middle American Archaeology and Ethnology*. Cambridge.
CIW-P	*Carnegie Institution of Washington, Publications*. Washington.
CTA	*Central Texas Archeologist*. Waco.
E	*Ethnos*. Stockholm.
EP	*El Palacio*. Santa Fe.
ESAF-B	*Eastern States Archaeological Federation, Bulletin*. Trenton.
FiA	*Fieldiana — Anthropology*. Chicago.
FlA	*Florida Anthropologist*. Gainesville.
ICA 31	*International Congress of Americanists, Anais do 31 Congresso Internacional de Americanistas*. São Paulo.
INAH	*Instituto Nacional de Antropologia e Historia*. Mexico.
K	*Kiva*. Tucson.
MARI	*Middle American Research Institute*. New Orleans.
MARR	*Middle American Research Records*. New Orleans.
Mas	*Masterkey*. Los Angeles.
MAS-B	*Massachusetts Archaeological Society, Bulletin*. Attleboro.
MoA	*Missouri Archaeologist*. Columbia.
NMC-B	*National Museum of Canada, Bulletin*. Ottawa.
NYSAA-B	*New York State Archaeological Association, Bulletin*. Albany.
OAS-B	*Oklahoma Anthropological Society, Bulletin*. Norman.
P	*Plateau*. Flagstaff.
PA	*Pennsylvania Archaeologist*. Homesdale.
PlA	*Plains Anthropologist*. Lincoln, Nebraska.
PPHR	*Panhandle-Plains Historical Review*. Canyon, Texas.
RCA	*Revista Colombiana de Antropología*. Bogotá.
RMEA	*Revista Mexicana de Estudios Antropológicos*. Mexico.
S	*Science*. Washington.
SAP-J	*Société des Américanistes de Paris, Journal*, n.s. Paris.
SJA	*Southwestern Journal of Anthropology*. Albuquerque.
SL	*Southwestern Lore*. Boulder, Colorado.
SM	*Scientific Monthly*. Washington.
TA	*Tennessee Archaeologist*. Knoxville.
TAS-B	*Texas Archeological Society, Bulletin*. Austin.
UA-AP	*University of Alaska, Anthropological Papers*. Fairbanks.
UCAS-R	*University of California Archaeological Survey, Reports*. Berkeley.
UCPAAE	*University of California Publications in American Archaeology and Ethnology*. Berkeley.
VFPA	*Viking Fund Publications in Anthropology*. New York.
WA	*Wisconsin Archeologist*. Milwaukee.
WHOM-N	*W. H. Over Museum, Newsletter*. Vermillion, South Dakota.

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